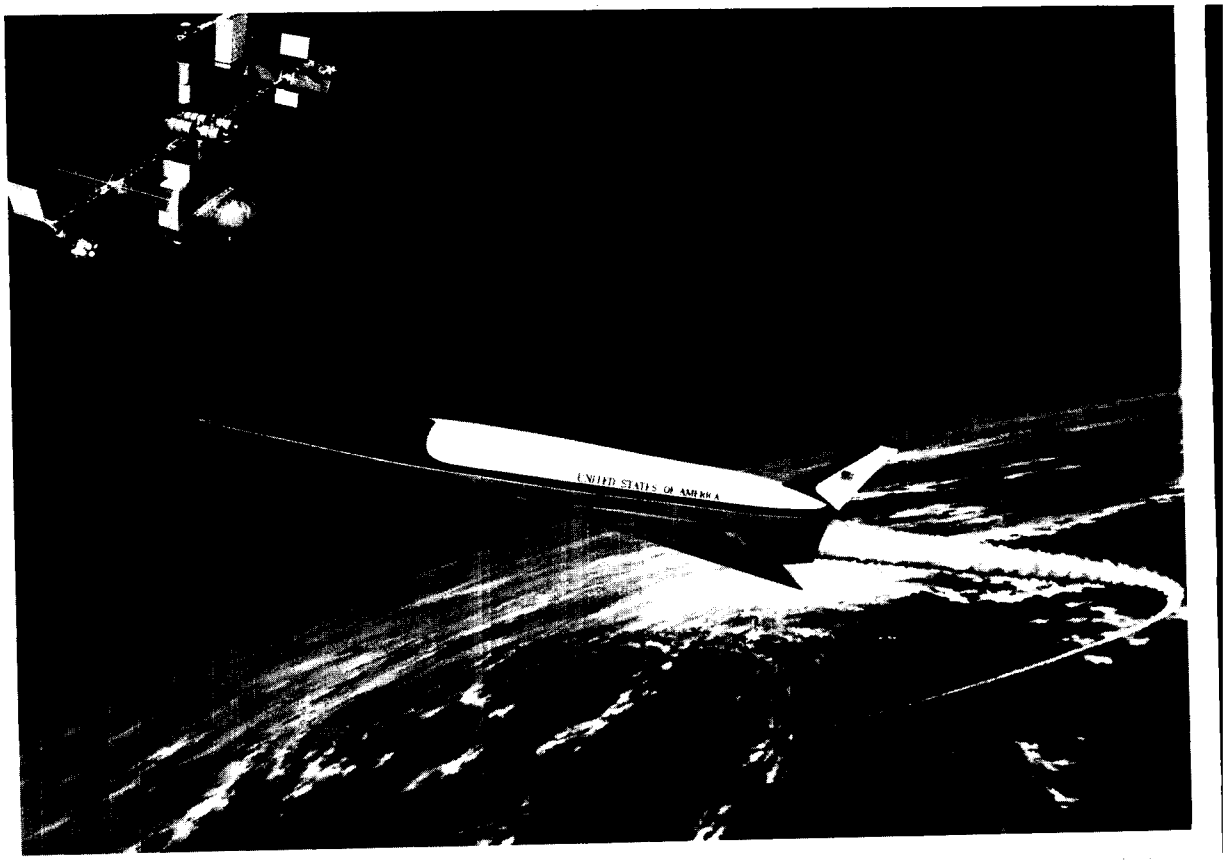
4th Annual NASA/Contractors Conference on Quality and Productivity

"Achieving Excellence Through Teamwork"

SUMMARY REPORT



Summary Report of the 4th Annual NASA/Contractors Conference on Quality and Productivity

"Achieving Excellence Through Teamwork"

Hosted By:
NASA Lyndon B. Johnson Space Center
Houston, Texas

October 27 - 28, 1987

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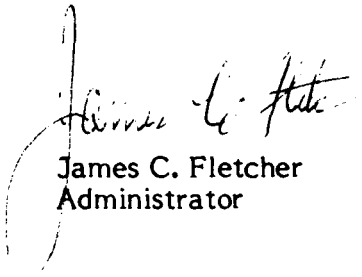
FOREWORD

NASA/Contractors:

The joint efforts of the NASA/Contractor team contribute fundamentally to realizing NASA's quality and productivity objectives toward assuring a superior national space program in the competitive world market. Successful teamwork is crucial, and sharing quality and productivity information throughout the NASA/Contractor network plays an integral role in achieving a culture of excellence through teamwork for NASA and its contractors. The last four NASA/Contractor conferences were successful catalysts that encouraged and supported this teamwork effort. These conferences serve as an educational and motivational medium to encourage quality and productivity throughout the NASA/Contractor team, and a fifth conference is already being planned.

This Summary Report on the Fourth Annual NASA/Contractors Conference is presented as part of a continuing effort by NASA to disseminate quality and productivity information to its NASA/Contractor team and to the public. We hope the information contained in this summary report will provide new ideas and reinforce the current, necessary trend toward improving quality and productivity.



James C. Fletcher
Administrator

DEPUTY ADMINISTRATOR REMARKS - DALE D. MYERS

The theme of this NASA/Contractors conference, "Achieving Excellence Through Teamwork" is particularly relevant as we approach the resumption of Shuttle flight. The time is right to work together. A strong, diversified, and imaginative civil space program contributes fundamentally and uniquely to our country's leadership in the world community. Although today our traditional preeminence in space is being highly challenged, I am confident that we have the talent, the will, and the support of the American people to preserve and, where necessary, to reclaim our leadership in space.

The NASA/Contractor team must play a critical role in restoring our access to space and in shaping our future course among the planets. The Shuttle schedule is progressing; the absolutely indispensible Space Station, key to all of our future operations in space, is moving steadily towards reality; and there is renewed, aggressive interest in commercial space operations.

As we move toward flight again, a variety of great observatories and dramatic planetary and solar robotic explorers with huge potential for the advancement of human knowledge and understanding will be scheduled for launch. The National Aerospace Plane is progressing from research to configuration concepts and the inspired aeronautics R&D is moving forward with zeal and continuing success. We have a very clear vision of what we can do and how to do it.

At NASA, we are studying the technologies, costs, and possible timetables of the nation's options in space. When the national policy and budgets say "Go," we will be ready. We have a total commitment of the Congress, the people of the United States, NASA, and the contractors with whom we work in the nation's cause to assure success. Nothing less than that kind of commitment will overcome the strong challenges that face the NASA/Contractor team and our entire national industry today.

We have vigorous foreign competition in many industries and the space program is no exception. The Soviets, Europeans, Chinese, and Japanese are all challenging U.S. space leadership. They and other nations rightly see space as an indispensible arena for science, industry, and security. They are developing well-planned programs and pursuing them with dedication, competence, and consistent and predictable funding.

These challenges can be met, and NASA is taking the lead in addressing them. Success will ultimately depend on the performance of the NASA/Contractor team. This calls for excellence across the board in contractor operations, the enhancement of product and service quality, and steady improvement in productivity to make sure that the nation gets the most out of every tax dollar allocated to the space program and to aeronautics.

We now need a rededication to excellence, a resurgence of creative and imaginative thinking at all levels of management, and the involvement of employees as respected and contributing participants. We have to do our job right because lives of the astronauts depend on it. We have to improve productivity because the public depends on it.

NASA strongly endorses the pursuit of excellence and optimum performance as reflected by the panels of this conference. We seek to share this commitment and will work with our contractor team at all levels to achieve these goals.

WELCOMING REMARKS - AARON COHEN, DIRECTOR
LYNDON B. JOHNSON SPACE CENTER

The theme of this Fourth Annual NASA/Contractors Conference on Quality and Productivity is appropriate in that it highlights the way NASA has done business in the past and it points the way to future successes. There are two shifts in emphasis from previous NASA/Contractors conferences: (1) An increased focus on quality, and (2) a growing recognition that NASA and its contractors can significantly improve quality and productivity efforts if these goals are tied more closely to future planning.

Past NASA programs were stand-alone efforts with definite start and end points. Future programs will require sustained operations for decades. This means that quality and productivity considerations must be tied in early. NASA and its contractors must significantly improve the way programs are designed, developed, and operated. Vehicles being developed must be designed as building blocks for the space infrastructure required to support more ambitious space initiatives such as, possibly, a lunar base or a manned Mars program.

NASA and its contractors must find ways to reduce costs early in the design phases of these programs. We must understand the operational interrelationships and design constraints which future programs impose. Most importantly, we must start early. We cannot defer design to a later date, nor can we depend on technical breakthroughs alone to achieve our goals. We must also improve our management systems and find ways to work smarter and harder. There is plenty of work to challenge us now and in the future.

INTRODUCTION - C. ROBERT NYSMITH, CONFERENCE CHAIRMAN

On October 27-28, 1987, NASA held its Fourth NASA/Contractors Conference on Quality and Productivity at the Lyndon B. Johnson Space Center, Houston, Texas. The theme of the conference, "Achieving Excellence Through Teamwork," attracted approximately 450 attendees; another 200 people were not able to attend because of limited space. This interest indicates an increasing awareness of the importance of quality in the space program. Top quality is the foundation of the space program. Equipment and systems must work right the first time, and every time, because we don't get second chances.

As we look to the future, it is clear that missions are going to become more challenging. Therefore, we have to build into NASA's culture an ethic that achieves the highest levels of quality and productivity improvement as a way of life. Many achievements have been made by the contractor community and within NASA to improve systems and procedures and apply technology for quality improvements. This conference was held to share experiences and successes. We also wanted to share lessons learned from applications which were not fully successful and to identify problems or barriers which still exist and need to be addressed.

Still another purpose of this conference was to honor the two recipient companies of the NASA Excellence Award. These organizations have achieved a level of excellence which is mainstream to the theme of the conference.

This report presents summaries of the conference panel presentations arranged in the following conceptual topics:

(1) Integrate quality and productivity improvements into future planning, (2) Enhance contractor relationships by defining team roles and through appropriate contract incentives, (3) Expand employee involvement and team building programs to improve organizational and system performance, (4) Develop systems that build quality into hardware and software products, (5) Support programs and techniques that encourage employee motivation, (6) Develop systems for measurement of productivity improvements, (7) Institute programs that reward excellent performance, and (8) A view to the future. Many of these topics are related, and appropriately so, as will be demonstrated in the summaries that follow.

It should be noted that this is not a verbatim proceedings document. The presentation summaries in this publication contain key ideas from the speakers' presentations as discerned by members of the Fourth Annual NASA/Contractors Conference Planning Team. You are encouraged to contact the speaker directly for more information on a particular presentation.

TOPIC 1: INTEGRATE QUALITY AND PRODUCTIVITY IMPROVEMENTS INTO FUTURE PLANNING

1.1 Space Station and Its Relationship to Productivity

Space Station is the next logical step in space exploration. As a permanent presence in space, 220 miles from Earth, it will be the key to the future. Not only will it be a symbol of United States leadership, it will serve as a national laboratory for a variety of scientific disciplines in the area of materials, life sciences and Earth observations. It will also be used as a platform for future activities. In the longer term, 20-40 years ahead, Space Station will enable us to leave the confines of Earth and further explore our Solar System. In the shorter term, it will enable us to qualify human beings for extended flight, gain experience in space operations, and develop associated new technology.

The Space Station will depend on the Shuttle for transportation. With five Shuttle flights a year required to support the Space Station, they are a matched pair. The Space Station must not only be inspirational and useful, it must be affordable. NASA and industry must factor in operational considerations at this point or the Space Station will not reach its full potential. If we cannot afford to build it in the mid-1990s and if scientists cannot afford to use it, we will have failed.

It is important to remember that the U.S. Space Station is a civil endeavor, international in character because of foreign partnership, and -- regrettably -- far behind Soviet Space Station endeavors. Congressional concern about the Space Station is high because of the heavy funding requirements, but congressional support is also high because of its pragmatic and symbolic value to the Nation.

For NASA, Space Station is a partnership with industry. Technologies are being developed in information systems for decentralized elements to communicate and to improve management. Not only will this experience benefit the NASA/Contractor team, but spinoffs will benefit industry as a whole. Similarly, a "software support environment" is being developed that will not only serve as a model for efficiency on Space Station, but will transfer to aerospace and American industry as a whole.

The Space Station Program is a management challenge of the highest order. Information systems developed by NASA with industry's assistance should lead to efficient and productive management practices.

(From a panel presentation by Dr. Terence T. Finn, Deputy Director, Policy Division, NASA Space Station Program)

1.2 Quality and Productivity Planning Should Not Stifle Research and Technology (R&T)

The pursuit of advanced or high technology is sometimes seen to be in conflict with productivity. However, this is not really the case. The problem is when and how technology is applied. Unfortunately, we tend to over extend ourselves in development programs, putting the risk in development rather than in technology where it belongs. We should be emphasizing technology to establish a technological base, thereby reducing risk in full scale development. After we fully understand the technology, the operations, and the characteristics of the performance of the systems tested in realistic environments, we should then delay full

scale development in order to build in margins which extend life and reduce development and operations costs. We cannot build in a margin for extended performance if we are developing technology to meet performance specifications after detailed design.

In today's world, high technology has become synonymous with complexity, but the best technology is elegant in its simplicity. As technology matures, it gets simpler in its application. When we use brute force in technology to meet performance specifications, systems become more complex and more risky. Simple is beautiful, but not because of compromise. The scale used to measure quality in R&T programs should be different from the scale used to measure quality in production/manufacturing programs. Quality in R&T means: (1) Advancing the state of the art, (2) identifying new concepts, (3) achieving breakthroughs, and (4) making inventions. This, of course, recognizes a process of false starts, many failures, and taking prudent risks. Sometimes we learn more from our failures than from our successes. We should not, however, be in a position of accepting failures caused by carelessness or sloppiness.

If we apply the same approach of quality assurance in research as we do in development and operations, we could smother the creative spark of inventiveness that must exist in a good research program. We should invest more in design to assure margins, then move technology along simply, and finally, be careful with the application of quality assurance in technology.

(From a panel presentation by Dr. Raymond S. Colladay, NASA Associate Administrator for Aeronautics and Space Technology)

1.3 External Relations Can Affect Productivity in the Future

Quality and Productivity have external as well as internal aspects because of NASA's high public profile. Today NASA is facing new challenges from several Executive Branch agencies, which have sought to encroach on traditional NASA programs by advocating privatization of some operations of space activities, commercialization of others and changing the rules on our foreign partners. NASA also has foreign competitors, including the Soviets, who are marketing their launch vehicles and seeking partnerships with other nations in future space ventures. There are constant challenges to the NASA budget. Because of the post-Challenger vulnerability of NASA in the public eye, elements of Congress have begun to micromanage and prioritize space programs and activities. NASA must actively resist external forces which are not working in the best interests of the civil space program and which could hurt productivity. It should not hesitate to take a pro-active role and an aggressive stance in getting more positive exposure. NASA must recognize and exploit its value as a repository of engineering and scientific genius, including its Contractor team capabilities.

When NASA's toughest critics have been forced to face the issues and the available alternatives, they have taken a more positive view of what NASA is doing. NASA must convey the facts about its program and its quality and productivity achievements to the public, instead of merely circulating them internally.

In addition, some internal relations should be enhanced. The civil service-to-contractor relationship is one of the best within government, but it can be improved. The Headquarters-to-Field Center relationship and Center-to-Center competition are sometimes stormy and could benefit from more mutual understanding. The manned

program and science communities ultimately have similar goals, but the relationships involved need increased dialogue. All of these elements must build teams and networks and work as cohesive entities to accomplish NASA's goals.

(From a panel presentation by H. Hollister Cantus, NASA Associate Administrator for External Relations)

1.4 Productivity Efforts Can Best Be Accomplished if Integrated with Strategic Planning - The Johnson Space Center Approach: Team Excellence

Johnson Space Center (JSC) initiated a Center-wide effort to develop strategies and plans for the future in consonance with evolving agency plans. The Center looked at its strengths and weaknesses; at its facilities, human resources and capabilities; at its economic and political factors; and at where the civil space program would be in the year 2000. The goal was to decide where the Center wanted to be and how to get there. The planning charter required rapid progress, quality products, and broad participation.

Broad participation, rather than a top-down approach, was a key aspect of the effort. All levels of personnel were involved; both junior and senior employees were encouraged to participate. A strategic plan was developed and published covering five major areas of emphasis at JSC: (1) National Space Transportation System, (2) Space Station, (3) Advanced Technology Development and Utilization, (4) Institutional Excellence, and (5) Relationships with External Constituents.

Development of the JSC strategic plan involving a broad cross section of JSC employees provided several benefits. JSC gained as a Center by establishing a base of information; it learned about previously unrecognized organizational attitudes and cultures as well as technical issues. The process opened communication channels across the Center and throughout the contractor community and established that technology was not the only real challenge; another challenge was to improve management systems and processes. Above all, the strategic planning effort called attention to the need for a joint effort by the entire U.S. space team.

Before work started on the strategic plan, a productivity task team had been formed to look at the direction and desired results of productivity initiatives. It was soon discovered that the term productivity was viewed as too limited to adequately cover the concerns being addressed by JSC's multi-faceted enhancement efforts. This led to the integrated approach known as the JSC Team Excellence Program, which now blends technology initiatives, strategic planning initiatives, and productivity initiatives.

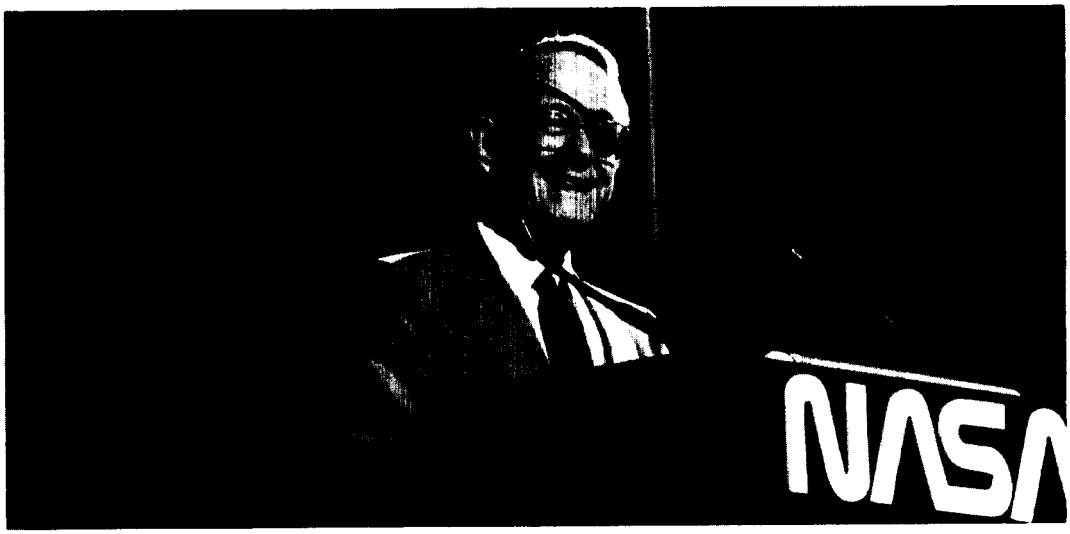
To promote awareness and integration of multiple activities, the Team Excellence program includes both Center-wide and directorate efforts. Based on suggestions submitted by various organizations, a Center-wide initiative in Small Purchases procurement was initiated as a horizontal enhancement effort cutting across the Center. Team Excellence Action plans within directorates to support directorate interests and concerns provided a vertical cut.

A six-step enhancement process was introduced at both the Center-wide and division level. This basic problem solving process includes (1) preplanning, (2) diagnostics, (3) objectives and measurements, (4) problem solving and action planning, (5) implementation, and (6) assessment and feedback. Organizations set their own parameters for measurement.

NASA employee teams were also incorporated into the program, with special emphasis given to joint NASA/Contractor teams and joint training techniques. Another team building effort was the quarterly "Team Excellence Forum" cochaired by JSC and contractor personnel. Initial forum members included JSC and its 25 largest contractors. The purpose of this forum was to enhance NASA-contractor and contractor-contractor working relationships and to provide a mechanism for addressing areas of mutual interest. The contractor community is very active in the forum and several working groups have been established. An incentive group examines ways to reduce costs equitably as it recommends innovative incentive techniques. A training group keeps up with the latest training material and techniques. Lastly, a measurements working group provides education, maintains a library, and issues a directory of involved contractors who serve as sources for exchanging information.

Increased participation - by employees, across organizational lines, and including contractors - is a vital aspect of the Team Excellence program. The goal is to increase awareness of the need to integrate quality and productivity improvement with everyday business activities as a way of life.

(From panel presentations by Daniel A. Nebrig, NASA JSC; William Huffstetler, NASA JSC; and Peter Sivillo, Singer Company)

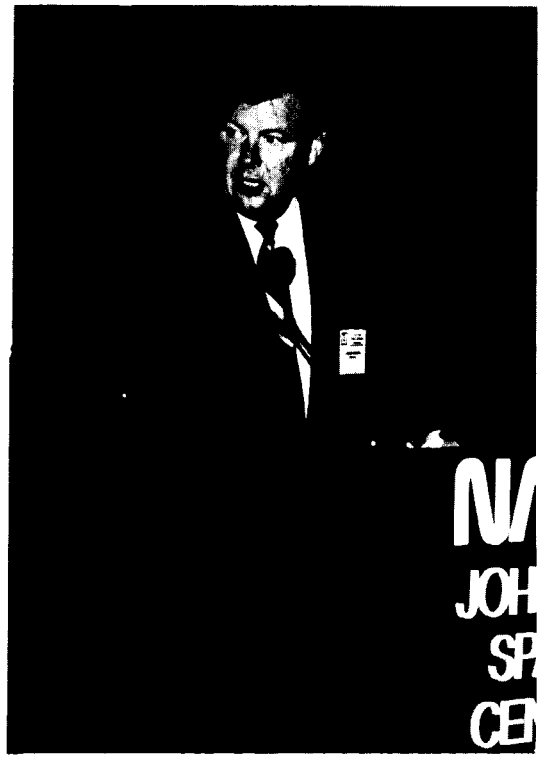


Dale D. Myers, NASA Headquarters

Aaron Cohen, NASA Johnson Space Center

George A. Rodney, NASA Headquarters

PANEL A — H. Hollister Cantus, NASA Headquarters; Dr. Terence Finn, NASA Headquarters; Dr. Raymond S. Colladay, NASA Headquarters



C. Robert Nysmith, NASA Headquarters

Joyce R. Jarrett, NASA Headquarters

PANEL B — David A. Geiger, Rockwell International Corporation; Joseph A. Bethay, NASA Marshall Space Flight Center; George A. Rodney, NASA Headquarters

TOPIC 2: ENHANCE CONTRACTOR RELATIONSHIPS BY DEFINING TEAM ROLES AND THROUGH CONTRACT INCENTIVES

2.1 Share the Responsibility for Prime and Subcontractor Quality and Productivity Enhancement

During the past 30-40 years the subcontractor's share of the prime contract value has changed from about 9% to over 60%. Subcontracting has become the largest single element of cost in today's aerospace programs. This transition has been caused by the growth in program complexity, systems sophistication, and higher overall performance requirements. In the past, many prime contractors had sufficient skills and capabilities to complete an entire program, requiring little subcontractor participation except as a source of commodities and raw materials. Today it is a shared involvement and responsibility. It is apparent that the subcontractor's performance can affect a program's performance. It can even adversely influence a prime's competitive advantage.

The importance of a subcontractor's performance is exemplified by: (1) The trend toward fixed price highly competitive programs budgeted under such constraints that affordability is a key factor in the selection of the subcontractor, (2) the customer's need for more visibility and involvement, down to the sub-tier level, especially on critical hardware, (3) audits, which focus significantly on the prime-to-subcontractor interface, and (4) targeted funds for new technical modifications to improve productivity of lower tier subcontractors.

The time for the prime and subcontractor to follow separate courses is over. They must become allies if they are to provide product quality and affordability to their customer. Efforts that lack commitment and involvement of executive management are of questionable value and will be short-lived. Employees have an uncanny ability to read management and react accordingly. Management must accept the fact that quality, productivity, and profitability all move in the same direction. Managing quality and productivity at the subcontractor level is not generically different from any other aspect of management and involves the formulation of strategy, the setting of goals and objectives, development of action plans, implementation of those plans, good communication, feedback, and action. One of the most important actions is taking the time to recognize and reward successful achievement of the subcontractor.

In some fixed-price contracts, the subcontractor's share is only 50% of the savings of value engineering applications. Some of the motivating factors which sustain such efforts despite the lower return are the prospects of follow-on contracts, the knowledge that any new innovation might have application to the subcontractor's total business and make them more competitive, and a reduction in their capital expenditures as a result of value engineering.

Improving quality and productivity at the subcontractor level is more than a matter of introducing new equipment or managing the prime-to-subcontractor interface; it means learning how to operate in a new, complex environment, supporting a continuing quality and productivity enhancement effort through commitment, action, perseverance and ingenuity. This requires a quality and productivity enhancement structure supported by senior executive management and consistent with the

company's culture. It must be understood by all employees. It must be a sustaining process and part of the subcontractor's strategic business plan, not linked to only one program. Finally, incentives must be established.

Some lessons learned from past and current programs are: (1) Involve the subcontractor early and define the responsibilities and accountability of both the prime and the subcontractor, (2) establish a strong technical and management team and continue that team throughout the life of the program, (3) do not overstate program requirements or present immature ones, (4) be generous with help where the subcontractor is lacking in depth, (5) understand the subcontractor's system of operating, both formal and informal, and advise of weaknesses, if there are any, (6) if the subcontractor's system works, use it--do not force the prime's system, (7) communicate early in the program and do it often, (8) respond quickly to suggestions and complaints to ensure a good rapport, (9) keep your involvement a continuing process, and (10) recognize that every contracting program is different and might require a different approach.

(From a panel presentation by Richard M. Davis, Martin Marietta, Panel Chairman)

2.2 The Traditional Prime Contractor's Role As A Subcontractor

Prime contractors (primes) are driven to teaming agreements because investments are considerable for today's extensive systems. This presents several interesting circumstances because primes in a teaming agreement during the competitive phase have to make a transition to a traditional subcontractor (sub) role. Unlike traditional subs, primes as subcontractors bring strength, indirect capability, many fixed assets, resources, experience, and a high level of knowledge on how to manage subs into their programs. There are several advantages to a traditional prime acting as a sub. With this arrangement, there is a designated single prime rather than an associate arrangement where neither has the prime role. It is easier for the government to do business with a designated prime, it helps the system integration load significantly, and it provides a considerable pool of resources. A designated prime has a power base structure that is part of its indirect or overhead cost that could be brought to bear on any problem at no additional cost to the government customer in terms of direct charges. The division of responsibility mitigates the strain on resources for any given contractor. However, care must be taken not to let redundant functions in each company do certain work twice. Another advantage is that development responsibilities are assigned along the contractor's strengths. Hopefully, teaming agreements in proposals are arranged that way.

Because a prime acting as a sub might be as strong or stronger than its prime, there are several traps to be aware of. A sub has to be disciplined from the cost-management and productivity viewpoints to keep from solving problems over the head of its prime. It has to stay focused on the job it has and not try to do a job it doesn't have, although it has the capability and its prime might be expecting help. When communication is strong, clear understanding might be assumed, although that might not be the case in the absence of firm requirements and specifications.

During the transition from teaming agreement to subcontractor role the company moves from investing company funds to spending government funds. Quality and productivity enhancement issues require that the contract and the interfaces be clearly defined. Because of costs and the investment of the company name and reputation, there is always the temptation of internal

executive and prime customer intervention at the higher levels rather than at the working level, where implementation is really needed. While teamwork is so necessary for success, it is important not to breed an informality in business interfaces that allows sloppy implementation.

The performance award fee can be used as a punitive tool to get responsiveness instead of as a reward system. From a quality and productivity enhancement program viewpoint, the incentive system is more effective, but care must be taken that it doesn't get misused at lower levels. Evaluators have to place their goals in perspective with the whole program. This trap exists between the prime and the sub as well as between the prime and the government customer.

The real dollars spent in hardware programs flow through the system. The fee or profit is just the tip of the iceberg. Program direction from primes to subs affects the entire system and how productive the subs are in the program. The prime must take a large share of the leadership and make sure that there is discipline at the subcontractor level; the sub must make sure that he stays aware of the hardware program change traffic.

The prime should reinforce good subcontractor management policies with a single line of authority in both organizations and with requirements defined at the start. Deliverables such as hardware, software, and documentation should be specifically defined. The prime should also assign a senior subcontract team composed of technical management, technical specialists, and a contract administrator and keep up a formal relationship. One helpful approach is the formal Memorandum of Understanding (MOU) which discusses how you are going to do business. The MOU does not replace the contract, which takes precedence, but the MOU might go a long way as a catalyst for efficient operation and for quality and productivity enhancement.

In addition, the prime should develop an understanding with the government customer concerning the rules of making contact with the sub, particularly the quality assurance interfaces that allow some informal government contact with the sub. Let the prime take the lead in informal government agency contacts with subs so that control is maintained. Set up a formalized review schedule; above all, treat the sub fairly and with integrity.

The subcontractor should maintain integrity and not undermine the relationship between the prime and the government customer. It is critical that the sub become part of the team and accept and perform its role as a sub. A sub should insist on formalized requirements, discourage informal contacts with the prime and the government customer, and maintain rigid control of changes.

If the prime and the sub are going to achieve excellence through teamwork, they have to understand the relationship and use it in the most productive way.

(From a panel presentation by Angelo Guastaferro, Lockheed Corporation)

2.3 The Traditional Subcontractor's Role

Traditional subcontractors have a narrower technology base, but they have a unique product or skill which makes their contribution extremely valuable to the prime.

Productivity is improved and the moral and interest of employees is greatly stimulated from visits by the prime contractor. Although some traditional subcontracts have precluded the subcontractor from initiating contact with the government customer, the government customer has never been prevented from contacting the subcontractor. Under these conditions, the ethical subcontractor who treats the

prime with integrity must immediately inform the prime of conversations with the customer.

Working with the prime provides the traditional subcontractor with several perspectives. The prime is a rival or a competitor in some situations; in others, the prime is a customer. The traditional sub has visibility into the prime contractor's internal processes and knows the negotiation strategies and reactions to adverse events which might occur on a program. Thus, the traditional sub can use this information to his own advantage, or to the advantage of the prime, depending on the circumstances of future contracts.

The prime who competes with a sub also learns a lot about the sub and can use that information in subsequent subcontracts with the sub. These relationships demand the best diplomacy and tact on the part of both the prime and the sub. The sub must treat the prime according to the particular situation, either as a customer, a teammate, or a competitor.

The sub can best perform by knowing a particular part of the business better than the prime, which makes the sub both a valuable teammate and a formidable competitor. The sub must concentrate on the basics and become a leader in product improvements. For a traditional sub to improve productivity, it requires management commitment, a team approach, and skilled facilitators. When doing business with several different primes, each with different requirements, internal processes should be analyzed and changes made for improvements and efficiencies. This improves communication, saves costs, gives better service to each customer, improves morale, and makes management more aware of the processes. It also requires the prime to get involved with the sub's processes. What is learned in improving processes is also valuable.

Productivity for a traditional subcontractor comes hard and with an immediate cost, but has a high payback when achieved. The entire process must be done with the full knowledge and support of both the prime contractor and the government customer. The prime contractor, the government customer, and the subcontractor all benefit from productivity improvements, and the entire team working together can find the answers.

(From a panel presentation by Lindsay Ball, Honeywell, Inc.)

2.4 The Award Fee Incentive Program - A NASA Perspective

Contract incentive programs are complex and difficult to administer. There are a number of incentive programs available for use such as value engineering, facilities investment programs, design-to-cost systems, gainsharing, productivity fee portion of award fee contracts, and others. There is no single best system; the system selected must fit the circumstances.

NASA uses cost-plus-an-award fee as an effective incentive technique. The fee is awarded on a unilateral basis, taking the contractor's performance and related circumstances under consideration. It is a flexible system and the evaluation plans can be adjusted. It also encourages more effective communication and fosters better management discipline on the part of both the government and the contractor.

The award fee contract is more of a management process than a type of contract. Each contract is different so each should be structured and administered differently.

Since the performance evaluation plan is not part of the contract, the government can make unilateral changes to it. The performance evaluation plan should be as simple as possible and motivate the contractor to make the best possible use of resources to improve performance.

The process should be equitable and timely. Evaluation plans normally cover technical achievement, business management, and cost control. Quality and productivity issues are also considered along with other special items.

The award fee contract does have some disadvantages which should be weighed against the advantages. Award fee contracts are costly and time consuming to administer. Evaluations and payments should be made promptly, but this is not always the case. Several functions may receive special attention in the criteria and the award fee might be splintered accordingly, causing the more important items to become less meaningful. Defining normal performance over and above which award fees are based can be difficult. Subjective judgments are made on performance, although meaningful indices would be much more useful if they could be established.

One controversial issue concerns the extent to which the government contractor should track awards given to the employees after the company receives its award. This could be part of the evaluation plan of a contractor's proposal or the government could track the flowdown after award. This issue warrants more study as does the amount of emphasis on quality, productivity, reliability and safety in award fee contracts. Each separate interest wants emphasis, but there has to be a balance.

(From a panel presentation by Leroy E. Hopkins, NASA Deputy Assistant Administrator for Procurement, Panel Chairman)

2.5 Return Contract Incentives to Earlier Concepts

The NASA/Contractor team may have had the answer to quality and productivity twenty years ago. New contract incentives are not the primary answers to the problems of product integrity and reliability. Other factors are far more important.

Well thought out product requirements, effectively defined in a system specification, properly funded during the initial design phases, and covered by a contract with a reasonable profit, is all the incentive a contractor needs to provide a high quality product. The two major obstacles of this approach, both a result of annual budget shortfalls, are firm fixed price contracts for development programs and the "Best and Final Offer" (BAFO) process. These two techniques cause excessive specification streamlining and strip away everything except bare essentials in the development effort, with a resulting decline in product integrity.

There are two additional techniques that might be used to reward and encourage increased quality and reliability. First, have an up-front bonus plan whereby the contractor would have to return the bonus dollars if high levels of system performance were not achieved. The second, which is used in aircraft development, is a value engineering type of incentive contract for reliability improvements, with the dollar amounts based on the extent of risk reduction achieved.

The aerospace industry, contractors, and the government customers should guard against further erosion of contracting integrity. Profit policies that erode earnings to substandard levels will not produce product integrity; delaying payments of contractor invoices to help balance the budget problem or create a cash flow solution will not produce better quality; delaying or suspending progress payments for "normal developmental rough spots" will not encourage design integrity; soliciting development contractors or imposing cost caps and large contractor contributions will not produce the best possible product; and threatening to jail executives for errors in certification is not the best method of motivation. You get what you pay for.

(From a panel presentation by Jacob J. Bussolini, Grumman Corporation)

2.6 Use of the Combined Fee - The Lewis Research Center Approach

The Lewis Research Center consolidated five fixed price contracts into one "class" contract involving logistics and administrative support services. This contract combines an award fee and a productivity fee. The award fee is an incentive for overall ongoing performance while the productivity fee is an incentive for specific efforts and actions to improve productivity. The productivity fee is divided into two parts, "actions taken" by the company in submitting suggestions to NASA for approval, and "actions directed" internally.

Actions taken are weighted 80% of the productivity fee, and are evaluated based on the contractor's "Productivity Enhancement Submittals." Efforts internally directed towards improving productivity are weighted 20%, and include such elements as actively pursuing productivity initiatives, developing meaningful goals, plans, and objectives, and creating an environment for improved productivity.

Unlike the award fee, there is no base fee under the productivity fee. The contractor reward is based solely on efforts taken to improve and the actual accomplishments. These efforts and accomplishments must affect work under the contract; credit is not given for actions directed by NASA or for actions covered in the initial proposal. As typical in incentive programs, there is a need for constant communication and feedback.

(From a panel presentation by Ronald Kiessling, NASA - Lewis Research Center)

2.7 Reaction to the Combined Fee - A Contractor's Viewpoint

The objective of a contract incentive program is to create an environment where the contractor, its management, and its employees can achieve sustained superior performance and give the government the most value for its contract dollars. Award fee contracts can be effective, but there are some reservations.

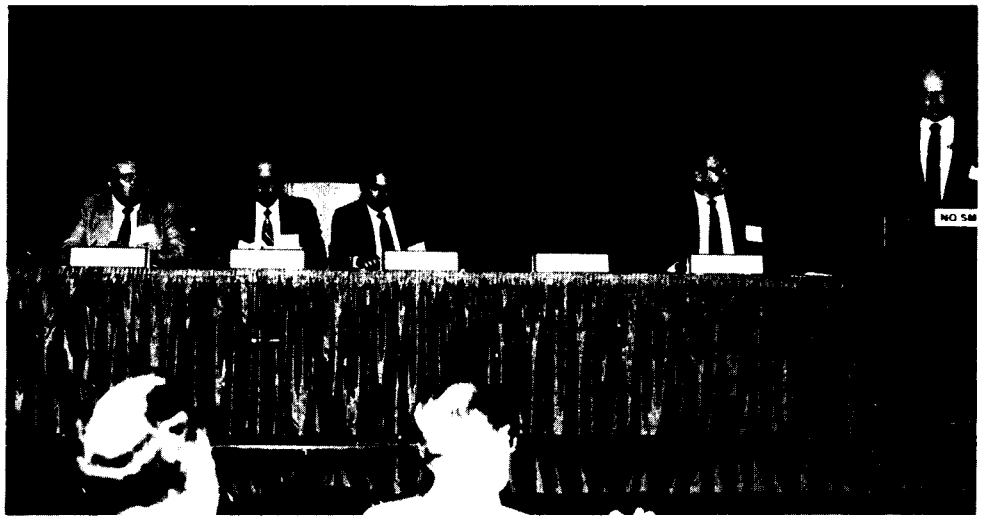
The award fee contract can be a negative incentive depending upon the grading criteria. The grading criteria needs to be reasonable and realistic. If a contractor provides excellent performance, there should be a reasonable chance of earning 100% of the fee. If a contractor provides excellent performance, but the net result is 80-85% of the fee, performance will eventually suffer. A contractor will invest its management resources and time in direct relation to its expected return on investment.

Motivating the contractor's management is not enough. The contractor's work force must be involved because they make a program work on a day-to-day basis. The contractor can set up the environment and the systems and procedures, but unless a program involves the employees, improves the quality of their work life, and provides financial rewards, it won't work over the long haul.

NASA should establish a productivity pool fee which would not be subjected to the downward pressures of competition or negotiation, and in conjunction with the contractor, develop reasonable grading criteria and establish specific goals and objectives. At the end of each year, the government should evaluate the effectiveness of the program, allowing contractor input. The award of the productivity fee should go directly to the contractor's work force for their efforts. To continue to motivate the contractor's management to support and sustain the program, the award fee score criteria should be partially based on

management's support of the productivity program. The three elements needed for a successful program are (1) a long-term commitment by the government, (2) a reasonable profit for the contractor, and (3) an effective work force climate where the employees are involved.

(From a panel presentation by F. Craig Wilson, Cortez III Service Corporation)



PANEL C1 — Larry E. Lechner, NASA Marshall Space Flight Center; John R. Wells, Morton Thiokol, Alfredo Bonilla, III, Brown and Associates Management Service, Inc.; Gerald L. Johnson, Boeing Computer Support Services; J. N. Foster, NASA Marshall Space Flight Center

PANEL C2 — Leslie J. Sullivan, NASA Johnson Space Center; Peter W. Sivillo, Singer Company; William J. Huffstetler, NASA Johnson Space Center; Daniel A. Nebrig, NASA Johnson Space Center; Robert B. Young, Jr., Lockheed Engineering and Management Services Company

PANEL C3 — W. Brian Keegan, NASA Goddard Space Flight Center; Thomas L. Clark, Computer Sciences Corporation; Jerome Barsky, Bendix Field Engineering Corporation; B.J. Thomas, IBM Corporation; Ray J. Rogal, Ford Motor Company; Gene Guerny, NASA Goddard Space Flight Center

TOPIC 3: EXPAND EMPLOYEE TEAM BUILDING AND INVOLVEMENT PROGRAMS TO IMPROVE ORGANIZATIONAL AND SYSTEMS PERFORMANCE

3.1 Johnson Space Center (JSC) Team Excellence Case Studies

Three representative examples of activities initiated as part of JSC's ongoing Team Excellence strategic planning efforts were described. These included:

(1) a division project aimed at assessing and enhancing division services and interfaces with the associated support contractor;

(2) a pilot effort to define a process for developing a technology and capability plan at a division level to support and implement Center strategic planning; and

(3) a joint JSC/Contractor project to define and simplify a complex set of relationships associated with a major program effort involving both government and contractor organizations and personnel.

The JSC Logistics Division initiated a team excellence project that involved both civil service employees and support services contractors. The project's goal was overall service improvement and it focused on organization, methods for measurement, and benefits derived.

A Project Steering Committee was established; its membership included senior managers and several employees. Task teams were then set up to identify and implement specific improvements in work processes. The services provided by the Logistics Division to the Center were identified and prioritized, recognizing that systems management and teamwork were essential to meet the joint requirements of the Shuttle and the Space Station. Teams were made up of employees from the related work areas and their tasks were assigned by management. These teams have been very effective, and the concept may be expanded in the future to include NASA Employee Teams (NETs), which are presently chartered to address work issues of their own choice.

Problem identification and goal setting were based on employee surveys and interviews. The implementation of "quick fix" improvements was fairly rapid and substantial enhancements in the services were seen. The process has improved teamwork and morale as employees saw their ideas implemented in their work areas.

(From a panel presentation by Elsie M. Easley, NASA Johnson Space Center)

The JSC Structures and Mechanics Division was selected as a pilot organization to see if it could identify new technologies or capabilities that might be needed to support longer range Center objectives, especially those interest areas supported by JSC senior management in strategic planning. The goal was to design a plan that could serve as a road map defining which technologies and capabilities would be developed and implemented to support major objectives such as a Mars mission and lunar based missions. The process proved to be challenging, but as yet, a final plan has not been completed. However, lessons were learned and the strategic planning process was instructive because it encouraged personnel and other organizations to address strategies of long-term

technology issues. A proper meeting environment away from daily activities plays an essential part in the ability of an organization to work on strategic planning, where a day-by-day mind set prevails on present projects. If goals center around immediate program needs, the development of a long range process for futuristic thinking will be hampered.

The major lessons learned were that such a planning effort requires careful orchestration, preparation, and priority to obtain wide support, continuity, and participation from personnel with different interests. Although it is a time-intensive activity in which a wide range of resources, preparation, and inputs are required, insights are achieved that enable personnel to better understand the organization and its capabilities and to address present project work in the context of a larger and longer range perspective.

(From a panel presentation by Lubert J. Leger, Ph.D, NASA Johnson Space Center)

A JSC/Contractor task team effort was initiated as part of the Team Excellence Program. This team consisted of "directed" volunteers from JSC, the Rockwell Shuttle Operations Company, and UNISYS. Issues to be addressed were identified, and a Steering Committee assigned the top task to a team that used the NETs process to come up with recommendations for clarifying accountabilities and responsibilities to streamline work processes, improve teamwork, and develop better communication. A key part of the effort was analyzing and breaking down work processes into distinctly identified elements, which were addressed in detail. Matrices were then developed as a framework for associating organizational elements and functions to conceptualize the total work flow with inputs, sub-steps, and outputs.

All of the organizations involved were requested to document their actual and recommended roles, responsibilities, and accountabilities. When the results are in, the team will define problems and recommend solutions for improving processes to the Steering Committee. The experience of working as a team on this effort has resulted in high group spirit and an eagerness to implement new improvements. More JSC/Contractor task teams are planned for the future.

(From a panel presentation by Rodney G. Rose, Rockwell International Corporation)

3.2 Beyond Quality Circles

In 1982, Langley Research Center (LaRC) became the first NASA Center to institute quality circles. While quality circles are very effective in work areas, there are currently no professional, technical personnel participating in LaRC quality circles. However, a pilot Performance Action Team has been formed and is now in operation. This team handles management-identified tasks and is made up of technical professionals, a support service contractor, and administrative workers. This pilot team might serve as the basis for future program direction.

(From a panel presentation by William L. Williams, NASA Langley Research Center)

The Hewlett-Packard Company expanded on the quality circle concept when it sought "Total Quality Control" (TQC) for its product line and services. This effort recognized that quality circles were operating apart from the management system and that team projects were not tied to management's top quality and productivity concerns. When it was found that in the face of more competition, the cost of nonquality for its products and services was very high, management established a highly

challenging goal: improvement by a factor of 10 for the company by 1990. This meant total involvement of the work force, not just volunteer quality teams, to achieve such a stretch goal. Successful TQC techniques used by a joint-venture company in Japan were studied and applied. These studies revealed that the quality of the total business relationship with the customer, the focus on the quality of products and services provided to the internal customer, and the quality of the products all improved with the implementation of TQC techniques. TQC requires universal participation, a teamwork approach to problem solving, and an operating philosophy of continuous process improvement. Working with TQC fosters a shared vision where groups map out the direction of future activities and how to measure success. Considerable savings have been achieved in many departments as Hewlett-Packard works toward its 1990 goal.

TQC has been applied to planning which involves all levels of management and employees. Annual plans are usable documents with clear and measurable objectives within a one year time frame. Planning is considered a process in a continual cycle with no beginning or end and it spans all functions of the business. With each annual review, analysis is made of the prior year's objectives and accomplishments. Stretch objectives are then set for the next year after changes or improvements are determined. All plans are interlinked in this highly structured process and they have the commitment of even highly reluctant senior managers. TQC has offered a much more effective approach to teamwork and has enabled breakthroughs in quality, productivity, and communication. It has also enhanced problem solving skills and personal growth of the employees.

(From a panel presentation by Julie Holtry, Hewlett-Packard Company)

Strategic plans were developed by Westinghouse Electric Corporation in the late 1970s which served as a basis for operations in its new and automated facility, the Westinghouse Electronics Assembly Plant in College Park, Texas. The main goals were to improve quality and productivity, and to assure customer satisfaction with cost and on time delivery. It was essential to involve all employees in this improvement effort and to acknowledge that high reliability was essential in the specialized area of electronics assembly for defense and space-related use. A computer integrated manufacturing strategy in a state-of-the-art facility had to consider how to blend systems and technology while improving the skills and knowledge of the employees.

A systems approach to "technology and people" was taken; its main elements were careful employee selection, team design, vigorous training, and a philosophy of open management. Self managing teams were developed and a systems approach was applied to broaden employee responsibilities and skills in the use of robotics and information resources to make manufacturing processes repeatable, stable, and dependable. The approach included skill block progression and a pay-for-knowledge system that emphasized team accountability and mutual respect for work competency and development. Ownership of the company goals and involvement in technical and interpersonal problem solving by all levels have come to mean quality in an open management environment that emphasizes growth and improvement of its employees.

(From a panel presentation by John G. Teixeira, Westinghouse Corporation)

3.3 Team Building Activities - Hardware Contractors

Team building can take many forms: (1) Multi-functional groups across an organization, (2) planning groups to

design a new fabrication facility, (3) multi-locational groups developing a multi-faceted information system, or (4) a division with a host of participative programs designed to foster innovation. In all cases, however, the goals are the same - quality, productivity, and excellence.

(From a panel summary by Larry Lechner, NASA Marshall Space Flight Center)

At Rocketdyne, where high power, high technology products are developed, there is very little, if any, margin for error; quality must come first. Multi-functional teams provide one important way to achieve desired quality.

There are built-in challenges to the team approach. "We've never done it this way before;" "the function will be weakened;" and "teams are only needed to solve specific problems" are frequently heard comments. New challenges require new responses and functions are not delivered; products are. Teams promote quality, provide accountability, and give employees pride in their work. To be successful, the team must consist of more than just company members. The customer must also be a member of the team to achieve a quality product. There are a number of examples of team successes including the introduction of robotic welding, reduction in flow time, reduced nonconformances, and improved daily work plans.

(From a panel presentation by Richard Schwartz, Rockwell International Corporation, Panel Chairman)

Perkin-Elmer Corporation stressed the importance of teamwork in meeting anticipated needs - the importance of acting rather than reacting. The company determined that fully integrated capabilities, cost effective processes, innovative solutions, and new technologies would be needed to meet the challenges of the 21st century in optics. In response to those needs, Perkin-Elmer called together a team that encompassed all areas of the company to help determine what manufacturing and engineering steps should be enhanced, what steps in processing could be eliminated, what could be done to optimize communication and integration, and what could be done to improve the process of innovation. The overall response to the challenge was to integrate all aspects of program execution under one roof. Thus, the Special Optics Facility (SOF) was born. The SOF is a 31,000 square foot facility featuring total environmental control, an optimized layout to support manufacturing flow, fully compatible handling equipment, a complete etching capability, and total vibration isolation. The SOF is "focused for effectiveness" by incorporating new and existing equipment into a single optimized facility that provides process integration and maximum versatility.

(From a panel presentation by Dr. Gregory M. Sanger, Perkin-Elmer Corporation)

The Lockheed Missiles and Space Company formed an interorganizational team composed of two contractors, three NASA Centers, and NASA Headquarters. This team was assigned the task of developing a Management Information System (MIS) for the Hubble Space Telescope project. The many demands that were to be placed on such a system and the need for six different site locations made the problem similar to fitting together the pieces of a puzzle. The team's job was to assemble these pieces into an effective and efficient picture. The objectives established for the completed system included automatic reporting, timely dissemination of information, increased visibility of problem areas, tools for performance analysis, and improved communication. In addition, the system had to handle schedules, costs, and

manpower and be able to integrate available information to meet project requirements. In short, it had to be capable of providing the means to automatically handle budget preparation, contractor reporting, and project management and planning.

The completed system successfully meets all of these needs. Contractor reporting is automatically accomplished with contractor input of pertinent information which is then formatted into required standard reports, as well as through interactive query. The official planning report process is also handled automatically in the appropriate format and includes graphics. Project management and planning are greatly enhanced by using the incorporated analytical tools and the automatically produced cost and schedule variance reports, and associated problem identification. In addition, the system provides the usual electronic mailing and calendaring capabilities and an extensive library system that allows recall of all stored data at any of the system locations. In the event of on orbit failure, this instant recall capability will greatly enhance the scientist's and engineer's ability to solve problems in a timely manner. The success of this team building effort was aided by an effective and efficient communications system.

(From a panel presentation by Janiss H. Graves, Lockheed Corporation)

Spar Aerospace Limited concentrates on team building through participation. In 1983, Spar committed to "...build a never ending participative process that creates a state of mind in all our personnel to find better ways to do their jobs." Robotics requires innovation and innovation is needed to encourage participation.

Over a dozen specific participation initiatives are in effect at Spar, including a share purchase plan, multi-discipline working groups, a computer purchase plan that allows employees to purchase computers for their homes at a discounted price, and innovation surveys. Management training is also conducted. This training process begins with surveys that assess management performance and then works through the stages of shock-anger-rejection to acceptance and finally to an action plan for improvement. Annual corporate planning meetings include nonmanagement representatives. A discretionary fund, outside the regular budget cycle, is available to foster innovative ideas. A divisional newsletter and lunch time forums are held every month with employees bringing a brown bag lunch and listening to speakers with topics of interest to the employees. Employee involvement levels in the participation initiatives range up to 90%. The driving force behind the multitude of programs offered by Spar to foster employee participation is their belief in the slogan: "People improve productivity; productivity improves people."

(From a panel presentation by Michael Parfitt, Spar Aerospace Limited)

3.4 Team Building Activities - Support Services Contractors

Following the Challenger accident, there were several government reviews and reports which recommended increased government oversight of launch facility processes and management systems, and an increased role in technical integration. This required a detailed review of contractual arrangements and procedures. Adversarial relationships were present that had to be removed. The Kennedy Space Center considered how to rebuild its NASA/Contractor team to work together more effectively. Communication was noted as one of the critical elements. To facilitate exchange of information and support, Memorandums of Understanding became the vehicle for role clarity and definition of responsibilities and

interfaces. Emphasis was put on keeping all team players informed; regularly structured meetings were held to brief personnel and to instill a sense of team commitment. The process is still evolving and it has the full support of management.

(From a panel presentation by Andrew J. Pickett, NASA Kennedy Space Center)

The NASA-Ames/Calspan experience has been one of mutual support and successful team building in operations and engineering, aerodynamic facilities support, and special projects such as balance calibration. The main problems that had to be overcome in support service team building, where there were many organizational interfaces, were: (1) Defining responsibilities accountability, (2) working cooperatively, and (3) allowing a free exchange of information. These challenges were met through appropriate planning, establishment of organizational interfaces for the resolution of problems, and involvement of experienced, motivated personnel whose abilities are often underestimated by management. It was observed that mutual support, interdependence, and involvement must be stressed at all levels to create team spirit among several organizations. These team building efforts resulted in: (1) Productive and dedicated personnel technically and personally matched to the job; (2) an understanding of different cultures, (3) compliance with critical schedules, (4) development of a team philosophy, (5) personal job satisfaction, and (6) commendations from participating organizations.

(From a panel presentation by Norman Struzynski, CALSPAN Corporation)

The EG&G contractor operation at Kennedy Space Center was greatly simplified as the number of organizations and labor agreements were reduced. Previously there were many subcontracts and labor agreements in place at KSC, but there were no employee development programs. EG&G set out to develop an environment of cooperation, good communication and feedback, and trust of the employees by management. Work simplification programs were established where teams studied work processes for improvement. Decision making, participative management, and risk taking were encouraged; management realized that employees should know the intent of the rules, not just the rules. Educational, career development, and reward programs are in effect to give employees a sense of belonging. The work force has been blended into a one-company team.

(From a panel presentation by Charles L. Gibbons, EG&G Florida, Inc.)

TOPIC 4: DEVELOP SYSTEMS THAT BUILD QUALITY INTO HARDWARE AND SOFTWARE PRODUCTS

4.1 Build Quality into NASA's Programs/Products/Culture

The essential ingredient and top priority for NASA's success is quality. To achieve this, NASA has sought to build a nonadversarial relationship with the contractor community. The NASA Excellence Award illustrates the strengths of this relationship. Recipients of the award exemplify the highest standards in products and services. We are now in a highly competitive international situation that necessitates teamwork to maintain technological viability.

NASA's Safety, Reliability, Maintainability and Quality Assurance Program involves the following key elements:

(1) Clear lines of responsibility,

(2) Definition of safety and quality plans,

(3) Adequate resources, including personnel (and an aggressive plan to build a career path in the reliability and quality assurance field for technically capable people),

(4) Systems through which to identify and address problems and take responsibility for decisions to proceed,

(5) Method by which to prioritize problems, and

(6) Management of risk: engineering judgment is no longer adequate; this needs to be handled on a more statistical basis.

The challenge of risk management is that it is difficult to precisely describe how high technology is reconciled with engineering judgment. The solution undoubtedly lies in greater use of statistics and probabilistic variable analyses. An ideal quality assurance program should be capable of assessing the risk involved and the counter-measures available. Although audits and inspections have been increasing, a wider perspective that supports and encourages technical competence and innovation is needed. We will probably not do away with conventional inspections, but we can see them as servicing objectives that go beyond the issue at hand.

Building quality in takes time. Processes must be studied, but the key is to make the change from an inspection mentality to a spirit of teamwork. NASA cannot make this transition alone; new concepts and fresh insights are needed. We must move creatively into the future.

(From a panel presentation by George A. Rodney, NASA Associate Administrator for Safety, Reliability, Maintainability, and Quality Assurance, Panel Chairman)

At the Marshall Space Flight Center (MSFC) there is a major thrust to put increasing emphasis on quality, safety, and reliability as functions in all of MFSC's programs, and as disciplines within the Center. Also, MSFC is committed to improving productivity.

The functions of safety, reliability, maintainability, and quality assurance (SRM&QA), which were previously decentralized, have been combined in one organization reporting to a senior engineer. Personnel from this new office are then co-located with the program offices to ensure effective

communication channels with each program, the Center Director, and the Agency's Associate Administrator of SRM&QA.

Concurrently, staffing has been increased with the transfer of internal senior employees and the hiring of external specialists. The work force at contractor plants has been increased permanently and additional contractor support personnel have been added to the staff at the new organization.

Training programs have been enhanced and the number of personnel receiving training has increased considerably. A plan for additional training includes the rotation of selected new employees through the SRM&QA Office. This is very effective for those interested in careers in the design and testing fields. It also heightens the awareness of other employees to these important disciplines.

Other activities giving emphasis to SRM&QA are scheduled reviews with the Center Director, visits by MSFC senior staff members to subcontractor and lower tier contractor plants, and conversion of major development contracts to award fee contracts with specific evaluation criteria aimed at improved SRM&QA.

New emphasis is being placed on motivational programs for MSFC and its contractors. Special attention is being given to NASA Employee Teams. The entire productivity program is being reassessed for possible restructuring and new emphasis. One effective NASA/Contractor team effort takes place at a productivity center at MSFC where new materials, processes, or techniques are developed and tested off-line. Successful developments that have been qualified and tested are transferred to manufacturing facilities. MSFC is making progress toward quality improvement in its programs, products, and culture.

(From a panel presentation by Joseph A. Bethay, NASA Marshall Space Flight Center)

Rocketdyne shares the desire to build rather than inspect quality into hardware products. To achieve quality hardware, two areas are key: (1) Supplier control of critical processes, and (2) nondestructive methods of verifying hardware quality. Nondestructive methods include x-ray penetrant techniques and a broader base of nonintrusive process monitors.

A new approach to annual supplier audits is used. Rocketdyne and customer teams conduct the audits looking at suppliers of critical hardware and critical processes. Suppliers are responsive in that they baseline their performance and they get an opportunity to feed back concerns for producibility and clarification of requirements. Suppliers are also invited to participate in joint audits of lower tier suppliers. While some of the results are painful, striking improvements are achieved.

Nondestructive inspection methods are mostly applied at the end of the fabrication sequence, making rework very costly. It is apparent that real-time inspections can save costs. MSFC and Rocketdyne are developing robotic welding with real-time inspections. As a result, significant improvements in the quality of welds have been made, although the process has not yet been perfected. There are two challenges for critical processes: (1) To better understand the variables that affect critical processes, and during the design and development phase begin to apply innovative inspection methods and controls, and (2) to include suppliers in the team concept. Audits, training, and workshops are important tools in keeping

suppliers current. Design engineers and specialists have to get out to the suppliers periodically to get feedback.

(From a panel presentation by David A. Geiger, Rockwell International Corporation)

4.2 Quality Up-Front

At Goddard Space Flight Center, keys to achieving quality are seen as: (1) A meaningful organizational commitment, (2) employee involvement, (3) a confrontation with technical issues, (4) resolution of production obstacles, (5) understanding of capabilities and limitations, and (6) involvement with the customer.

(From opening remarks by W. Brian Keegan, NASA Goddard Space Flight Center, Panel Chairman)

The Computer Sciences Corporation (CSC) has a software methodology that is built upon strong project management, solid systems engineering, and a consistent software development program. The essential elements are to stay progressive, to study the process, and to build in quality rather than rely on testing.

Quality is both a management and a technical issue, though projects most often fail for management reasons. Managers must attend to costs and schedules but also to quality issues. Thus, the management and the technical issues are interwoven to achieve quality. The central elements of good quality software products are in the requirements and the design. Management must encourage feedback on problems discovered downstream during the developmental phase.

At present CSC is realizing that proven designs must be re-used to reduce life-cycle costs; this underscores the importance of reliability and maintainability. At CSC, all project members are responsible for quality. However, there is also an independent quality office. The emphasis on quality at CSC has brought about significant improvements in company products and a beneficial shift in the distribution of costs because of savings in the implementation of designs and related testing.

(From a panel presentation by Thomas L. Clark, Computer Sciences Corporation)

At the Bendix Field Engineering Corporation, the theme is "Doing It Right the First Time." This translates into doing today's job accurately rather than correcting yesterday's mistakes. An organization must move from an attitude of problem resolution to problem avoidance.

Bendix documents its goals so that they can be periodically reviewed and analyzed. This procedure involves: (1) Communicating the organizational goals to the employees, (2) continually monitoring progress in achieving the goals, (3) having a system by which to red flag problem areas, and (4) holding formal reviews at regular intervals. A key ingredient is the involvement of employee teams. Institution of this goal setting/review process at Bendix and teamwork with the customer have brought about a 30% gain in productivity per year. Also, the operations proficiency has almost reached 100% because of the internal assessment process.

(From a panel presentation by Jerome Barsky, Bendix Field Engineering Corporation)

In the Federal Systems Division of IBM, a computer upgrade for the Shuttle had to be made. This necessitated an assessment of past problems, leading to the discovery that better supplier products were required. The supplier

improvement effort chiefly involved source inspection and testing to assure reliable parts. To realize the computer upgrade, several key factors were involved: (1) Inspection techniques were improved, (2) quality awareness efforts were instituted, (3) a proven design was used as the basis for the new design, (4) process improvements were made, (5) temperature testing was expanded, and (6) the resulting new computer was proven by system testing preproduction units. The current status of the upgrade is considered very satisfactory since 30,000 hours of operation have been logged with only one failure.

(From a panel presentation by B.J. Thomas, International Business Machines Corporation)

The Ford Motor Company's "Total Quality Excellence Program" brought about a complete turnaround in quality. This change required that improvements had to be made, such as: (1) A commitment by management to a new mode of operation, (2) a recognition of the value of personnel resources, and (3) a realization of the potential of teamwork not only by the employees, but also by the suppliers and dealers. Through the assistance of W. Edwards Deming, management realized that it bore fundamental responsibility for flaws in the work processes and for lack of consistency in company goals.

Ford's program involved a cultural change, viewing quality in the broadest terms and aiming toward continuous improvement. The real definition of quality is provided by the customer, including the internal customer. In this vein, Ford now has a continuous improvement model that is aimed at customer satisfaction. This includes the key aspect of cost: high quality must be delivered at a cost that represents value to the customer. The model is necessarily dynamic. Continuous improvement is integral if it is to meet the needs of the customer.

(From a panel presentation by Ray J. Rogal, Ford Motor Company)

The General Electric Astro-Space Division uses two distinct approaches to achieve productivity improvement: (1) Capital investment in facilities and major equipment to simplify work and improve product quality, and (2) more efficient performance of routine activities, including the elimination of unnecessary tasks. Although these concepts are not new, top management recognizes that developing a culture that consistently emphasizes productivity improvement ideas and promotes their implementation is a top organizational priority. This theory applies no matter how small or how trivial the ideas may seem. Productivity improvement is incremental and management's sincerity in these concepts is deeply rooted.

An easy-to-complete form is used, designed to let all employees know that their ideas are presented to top management. The ideas are reviewed as a group and innovative approaches or derivations are disseminated when they are applicable to other organizational elements. Employees feel comfortable enough to question tasks that they themselves perform without fear of job security. Employees understand that the best, most recognized employees are the productive employees. They can easily become more productive as long as an atmosphere of open communication is present and supported by management. The results have been very successful. Employees look for problems or inefficiencies and recommend solutions even when the content is beyond the normal scope of their jobs.

Productivity initiatives have resulted in fewer shop defects, reduced rework time, less repairs, and reductions in scrap costs. Emphasis is placed on doing the job better up-front and concentrating on the end items that meet customer

specifications. In some cases, the results of specific initiatives have been directly traceable, but it is the cumulative effect of many small initiatives that contributes to a productive organization. Productivity means doing the job better than the norm. It is an attitude of responsiveness to the customer's and management's expectations.

(From a panel presentation by Peter L. Kujawski, General Electric Company)

PANEL D1 — Debra Owens, American Society for Quality Control; Dr. Gerald C. Swanson, Boeing Aerospace Company; Eugene N. Elleman, Cortez III Service Company; Peter L. Kujawski, General Electric Company; Peter W. Sivillo, Singer Company; Franklin R. Hagy, EG&G Florida, Inc.; Dr. Marco Giardino, Pan American World Services; (Not Pictured — Ronnie E. Carter, NASA National Space Technology Laboratories)

PANEL D2 — Rodney G. Rose, Rockwell Shuttle Operations Company; Lubert J. Leger, NASA Johnson Space Center; Elsie M. Easley, NASA Johnson Space Center; Paul J. Weitz, NASA Johnson Space Center; Leslie J. Sullivan, NASA Johnson Space Center

PANEL D3 — William L. Williams, NASA Langley Research Center; Julie Holtry, Hewlett-Packard Company; John G. Teixeira, Westinghouse Electric Corporation; (Not Pictured — Sidney F. Pauls, NASA Langley Research Center)

TOPIC 5: SUPPORT PROGRAMS AND TECHNIQUES THAT ENCOURAGE EMPLOYEE MOTIVATION

5.1 The Key to Quality and Productivity is Motivation - A Small Company's Approach

At Brown & Associates Management Services, Inc. (BAMSI), a support services contractor to the Marshall Space Flight Center, quality and productivity are enhanced by a motivated work force. Employee recognition and incentive programs are in place that lead to individual commitment and motivation. A participative management style is a primary objective in an environment that has 85% of the work force unionized.

Education and training programs are available to help employees become more proficient. Subjects covered are both technical and administrative, and tuition is reimbursed for outside classes when they are job-related. These programs help develop personnel for management positions, thereby sustaining the company's commitment to promote from within.

Employee participation programs are encouraged. The employee suggestion system has been very successful, and it is supported by all levels of management and by the union, which at the beginning was resistant. The number of suggestions and the cost savings have been increasing yearly. The keys to success are: (1) Timely evaluation, (2) good follow-through for implementation, and (3) feedback to employees of non-acceptance. The quality circle process is seen as an opportunity for employees to participate in decision processes. Teams are very interested in analyzing and solving fairly complicated problems. Extra vacation time and a percentage of costs saved are awarded to teams whose suggestions have been implemented.

Other recognition programs include: (1) Employee or supervisor of the quarter, which makes one eligible to be selected as employee or supervisor of the year, (2) custodian of the year, and (3) an annual employee reception. Selection criteria for programs are based on quality, productivity, and other performance factors.

The government customer is also supportive of employee recognition efforts with the NASA Manned Flight Awareness Program, the Center Director's Commendation, and group achievement awards. These programs have contributed to employee motivation.

Good labor relations have been developed with both union and non-union employees. To maintain good communication, regular meetings are held to discuss policy and operational issues. Brainstorming techniques are used to uncover problems, areas of concern, and solutions. Union representatives are included on the Productivity Steering Committee. Non-union employees' pay increases are tied to performance.

Several activities are in place to encourage a team atmosphere. "Brown bag" lunches enable employees to hold question and answer sessions with senior management who also maintain an open-door policy and conduct walk-throughs for direct contact with employees. A quarterly quality circular is published containing information about employee activities and achievements.

To give employees feedback about their performance, completed work orders are reviewed at random for discrepancies, and employees are informed of results. Similarly, interviews are held with the

government customer concerning performance and the quality of work, and the results are reported back to the employees.

Several lessons were learned from the productivity improvement and employee motivation efforts: (1) There must be commitment at all levels of management, (2) the government customer must be involved, (3) employees must know the goals and objectives of the program; and most importantly, (4) all employees who know the work should have a say in how the operation is run. When these goals are achieved and an appropriate reward system is implemented, motivation, improved quality, and productivity are possible in a union environment.

(From a panel presentation by Alfredo Bonilla, III, Brown & Associates Management Services, Inc)

5.2 Regaining Employee Motivation - A Large Company's Approach

After the Challenger 51L accident, the Morton Thiokol Company perceived itself as having become a focal point of the nation's emotional wrath. At that time the company had 1400 employees and morale was devastated.

To convert from a manufacturing environment to an engineering redesign and testing environment, operations were reduced by 40%. Many employees were transferred to non-space divisions, and approximately 300 were terminated. The work week was reduced in non-critical areas, and many employees left because they were not satisfied with the work environment.

The morale crisis was addressed by management in small employee discussion groups and inputs from quality circle participants. It was found that employees were experiencing a high level of job dissatisfaction, based on feelings of diminished accomplishment without possibility for improvement. Harsh treatment of Morton Thiokol by the news media, which was considered unfair, was particularly painful. Employees felt a personal involvement with the Challenger loss and they were concerned about lack of present long-range job security.

After some top management reorganization, informational and motivational discussions were held with employees. Communication focused on teamwork and mutual support, safety, quality, problems, and successes.

As conditions improved, the company went to a 7-day, 12-hour shift, whereby employees worked four days one week and three days the following week on a rotation basis. This work schedule appeared to raise morale, and 90% of the employees wanted it to be a permanent arrangement.

Seminars were held to make managers and supervisors sensitive to the employees' feelings and fears. Quality circles and employee suggestion programs were active. A consulting organization was contracted to provide an employee assistance program that included counseling for those who wanted help. This program helped relieve much of the trauma from the Challenger accident.

As project activities increased, additional employees were hired to meet new schedules. Job dissatisfaction declined, and employees became more involved with productivity issues. A monthly newsletter, posters, and promotional campaigns were geared to involvement of employees and their families in safety, quality, and productivity efforts. Videos were produced summarizing work progress. One of the most successful programs was a contest in which employees' children and grandchildren up through high school age produced posters on safety. The contest winners each received a $200 savings bond.

Other motivational activities included the reactivated Manned Flight Awareness Program with its Silver Snoopy awards, visits by astronauts to the plant, a personal finances class where employees can earn college credit, improvements in the suggestion program with the reduction in response time to three weeks, and a "right-to-the-top" safety program with simple forms for problem identification. A $500 savings bond is awarded for accepted life-safety suggestions.

The quality circle program is very active with the best circle in a 6-month period receiving a recognition dinner with a family member, a laser-engraved plaque, and two days of extra vacation.

In summary, the recovery from the Challenger accident is progressing at Morton Thiokol. Morale is improving and all organizational levels are working together as a team. New, improved communication and training initiatives have produced positive results. Morton Thiokol employees are fully dedicated to safety, quality, and productivity in an environment which recognizes that an employee motivation program must be part of the overall business plan.

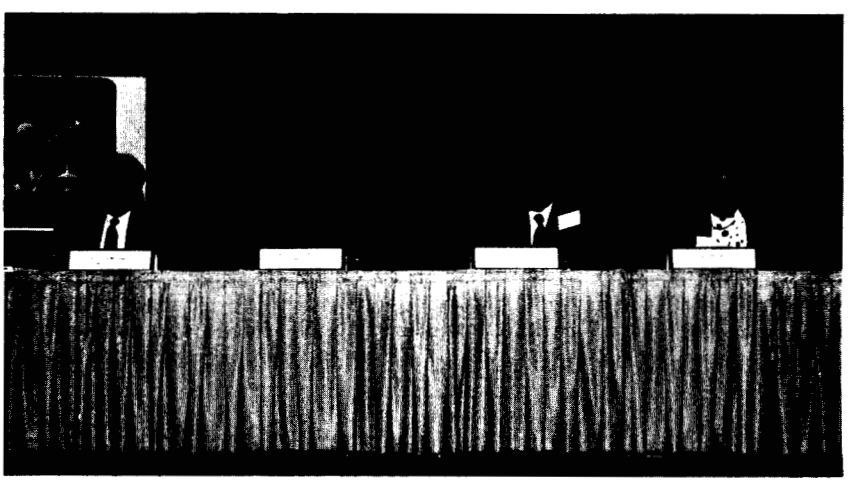
(From a panel presentation by John R. Wells, Morton Thiokol)

PANEL E1 — Michael Parfitt, Spar Aerospace Limited; Janiss H. Graves, Lockheed Missiles and Space Company, Inc.; Dr. Gregory M. Sanger, The Perkin-Elmer Corporation; Richard Schwartz, Rockwell International Corporation; Larry E. Lechner, NASA Marshall Space Flight Center

PANEL E2 — Norman Struzynski, CALSPAN Corporation; Charles L. Gibbons, EG&G Florida, Inc.; Andrew J. Pickett, NASA Kennedy Space Center; Warren L. Camp, NASA Kennedy Space Center

PANEL E3 — Lezley K. Wilson, NASA Ames Research Center; Frank E. Doherty, Office of the Assistant Secretary of Defense for Production and Logistics; C. A. Ordahl, McDonnell Douglas Astronautics Company; John S. Kempey, Grumman Corporation

PANEL E4 — Angelo Guastaferro, Lockheed Missiles and Space Company, Inc.



PANEL E4 — Richard M. Davis, Martin Marietta Corporation; Lindsay Ball, Honeywell, Inc.; Joyce R. Jarrett, NASA Headquarters

TOPIC 6: DEVELOP SYSTEMS FOR MEASUREMENT OF PRODUCTIVITY IMPROVEMENTS

6.1 The Performance Objectives Matrix as a Team Measurement Tool

The most important thing to know in a productivity improvement measurement program is why productivity is being measured. The Performance Objectives Matrix (POM), developed at the Oregon Productivity Center, helps employees improve their performance. The employees measure themselves and control the system, thereby receiving needed feedback. The POM is a diagnostic tool that helps identify obstacles to performance and it is especially useful for teams already in place practicing participative management. Another important attribute of measurement systems is that they improve communication.

The POM system is clear, concise, and requires only a minimum of paperwork. It uses weighted performance criteria selected by the employees. Scores for dissimilar functions are normalized and when multiplied by the weights, form a baseline from which to monitor progress. Teams set goals, establish milestones, collect data, find solutions to remove obstacles, and assess the effectiveness of their solutions. Teams are motivated to improve their scores as they monitor their progress. Both subjective and objective items can be measured.

The system does have pitfalls which should be noted: (1) Employees' reactions to a measurement system must be taken into account, and (2) if cash awards are used, employees might become overly conservative, less innovative, and take fewer risks.

(From a panel presentation by Dr. Marco J. Giardino, Pan Am World Services, Panel Chairman)

6.2 The Performance Objectives Matrix as a Measurement Tool in an Engineering Organization

In engineering functions, the various tasks require a flexible measurement system. Also, employees will work toward the objectives that are measured, so the system must be broad enough to encompass overall performance. The system must be understood by management and employees alike and it must be non-punitive in intent and implementation.

The Performance Objectives Matrix can be used in an engineering organization to measure and improve three attributes: (1) Quality of work, (2) quality of work life, and (3) quality of management. The quality of work includes costs, schedule, performance, and the quality of engineering design. The quality of work life refers to the work assignment and if it sufficiently challenges the individual. It is a subjective measure and is more credible if it has wide organizational coverage to offset individual extremes.

The quality of management includes three measurement subsets. First, the amount of turnover is an indicator of employee satisfaction in an environment. Second, measurements are made of employee involvement in activities available to them. Third, evaluations are made of the quality of

management of the entire organization. Criteria for management evaluation are established and employees are asked to evaluate when goals have been set, how clear they are, and whether they can contribute to them. Communication is also measured, as is the opportunity for advancement, the ability to treat workers with respect, teamwork, and participation.

Standards are set so that goals are reached in one year, after which scales are reset for the next period. Continuous improvement is sought throughout the entire organization. Measurement of a pure engineering research function, however, has not found very much success.

(From a panel presentation by Dr. Gerald C. Swanson, Boeing Aerospace Company)

6.3 Measurement Systems Require the Sharing of Information

The Johnson Space Center (JSC)/Contractor Team Excellence Forum has established a measurement working group to expand Forum members' knowledge about productivity measurement. The group is composed of representatives from eight organizations which include NASA and local contractors.

Because productivity measurement is a relatively new field, the group is concentrating primarily on the area of education, and several seminars with expert speakers have been held. These covered such topics as the objectives matrix and the measurement programs of three contractors (representing hardware, software, and support service) that were finalists for the 1986 NASA Excellence Award, including the two award recipients. Seminar attendance has exceeded 70 contractor and JSC representatives.

The working group has also assembled and distributed a directory of local contractors with experience or interest in measurement to facilitate sharing of ideas among forum members. In addition, a measurement section has been established in the JSC library; this section is expected to grow as new information evolves.

(From a panel presentation by Peter W. Sivillo, Singer Company)

6.4 Function Point Measures for Software Development

The software industry has long been looking for an effective way to measure software development and maintenance productivity. In the late 1970s, IBM developed a promising new measurement tool called "Function Points." Function Points measure a unit of software based upon its external attributes, such as inputs, outputs, logical files, interfaces, and inquiries. These attributes are counted, weighted, and summed. This sum is then weighted again based upon specifically defined complexity factors in order to arrive at a net function point total for the system or unit of software. This total becomes very meaningful as a quantitative measure when comparisons are made.

As with most measures, Function Points cannot be used to measure total productivity of a project. Supplementary tools are needed to measure such items as skills, staffing levels, schedules, and costs. The advantage of the Function Point process is its ability to measure projects and systems that use different programming languages, operating systems, and hardware. The process is not limited by technology; it is expandable and can cross boundaries of all types of hardware and software. This allows management to make more meaningful productivity comparisons and more informed decisions on improvements.

EG&G of Florida, Inc. has established a pilot project to determine the

applicability of Function Point measurement in the Kennedy Space Center environment. The project is focusing on the benefits that can be derived from improved productivity and thus reduce costs based upon management's ability to make decisions using a broader information base. If the pilot project is successful, Function Point measurement will become an active tool in the development and maintenance of EG&G software processes.

(From a panel presentation by Franklin Hagy, EG&G Florida, Inc.)

6.5 A Leveling Technique to Measure Productivity

The Cortez III Productivity Program has been evolutionary in nature, moving from a data gathering phase to a measures definition phase, and resulting in a system that measures task productivity, organizational productivity, and the productivity of several specialties. Because each of these has different characteristics, a method of leveling has been devised for comparison purposes.

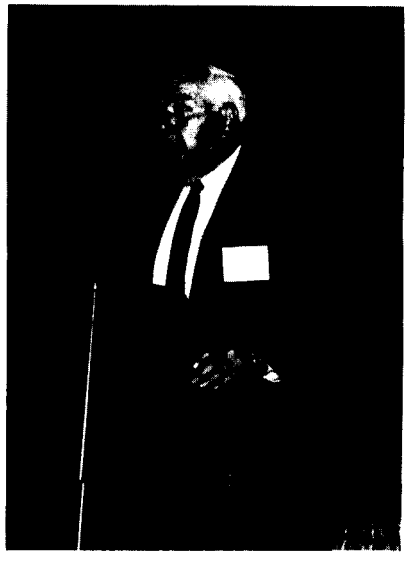
Over 175 production items are monitored monthly, using Lotus 1-2-3 spreadsheets. Productivity is measured by monitoring labor hours applied to each task and obtaining resultant ratios. Labor was selected as the measurement denominator rather than equipment, raw materials, or energy because the primary resource provided to NASA is a trained labor force. To normalize the different productivity scales from the various organizations, leveling is performed. Each ratio is divided by its own 12-month average to obtain a base near 1.0 and the results are plotted. Thereafter, each month's deviation can be read as a direct percentage difference from the first year's average, thus enabling organizations to be compared. This method has been very effective in measuring total productivity.

Other productivity improvement efforts in effect are suggestion systems, employee involvement, cross training, a newsletter, and performance awards. Another program receiving major emphasis is a bonus plan where the entire productivity fee earned under NASA contract is equitably distributed to the employees.

(From a panel presentation by Eugene N. Elleman, Cortez III Service Corporation)

PANEL F — C. Robert Nysmith, NASA Headquarters; Anthony J. Macina, IBM Corporation; Saul R. Locke, Martin Marietta Corporation

Anthony J. Macina, IBM Corporation



Saul R. Locke, Martin Marietta Corporation

PANEL G — David J. Steigman, NASA Lewis Research Center; Leroy E. Hopkins, NASA Headquarters; C. Robert Nysmith, NASA Headquarters; Ronald Kiessling, NASA Lewis Research Center; F. Craig Wilson, Cortez III Service Corporation; Jacob J. Bussolini, Grumman Corporation

TOPIC 7: INSTITUTE PROGRAMS THAT REWARD EXCELLENT PERFORMANCE

7.1 Department of Defense (DOD) Pilot Gainsharing Programs

Unleashing ingenuity and creativity requires partnerships between organizations and within organizations. Recognizing that quality is the ultimate goal (with quality defined as also satisfying customer needs), gainsharing can be a pivotal element to achieve it. The DOD gainsharing pilot programs have had very positive results thus far. There are 25 active programs with industry at the present time. Gainsharing is authorized in the U. S. Code and by decisions of the Comptroller General. A General Accounting Office (GAO) review of 22 programs has shown that they were successful in reducing costs while achieving other indirect benefits such as reduced absenteeism.

The DOD is interested in acquisition streamlining. This means making improvements in requirements definitions and putting more emphasis on quality earlier in the manufacturing process. It is important to receive feedback from contractors on the initial requirements imposed on them. DOD quality programs have not been integrated before, but now the DOD wants to make in-plant inspectors auditors of quality systems rather than inspectors, looking at all phases of engineering and manufacturing processes.

There has been too much emphasis on paperwork and not enough on the product. Continuous process improvement is the long term goal. To do that, a motivated work force is needed. If employees' ideas are implemented, they will be motivated, especially if they are rewarded.

The DOD "performance base incentives" or gainsharing uses a formula whereby costs saved are shared 50% by the government and 50% by the employees. Performance must exceed predetermined standard levels with consistent quality. One problem which surfaced is that compensation specialists must deem the rewards reasonable in view of prevailing wage rates in the geographical area, or justify exceptions. Another problem is concerned with projecting productivity gains into the price of future contracts. However, experimentation is encouraged.

Success of gainsharing programs requires top management support, work force and union support, a necessary backlog, an accepted measurement system, and incentives. The "DOD Guide for Design and Implementation of Productivity Gainsharing Programs," March, 1985 is available as a guide for establishing a gainsharing program. A key decision alternative is whether a goal should be increased output or process improvements.

Another DOD effort approved by the Office of Personnel Management is a five-year demonstration project at the Sacramento Air Logistics Center, McClelland Air Force Base, California. Approximately 2,000 employees will be involved with 50% of savings returned to the employees. Later, DOD intends to transfer successful techniques to industry on a broader basis. Other pilot programs such as value engineering and industrial modernization incentive programs will also be used.

(From a panel presentation by Frank E. Doherty, Department of Defense, Panel Chairman)

7.2 A Contractor's Pilot Gainsharing Program

The McDonnell Douglas Astronautics Company has a pilot gainsharing program whereby employees share rewards on a project by project basis. When corporate earnings are above specific threshold levels, 50% of those earnings are shared with the employees, thereby rewarding their high performance in meeting schedules and achieving the financial gains. After two years into the pilot program, one-third of the employees are involved. Later, all employees, including support groups, will be covered using different reward criteria formulas.

In a gainsharing program, the objectives must be clear and easy to communicate. When rewards are achieved, they are distributed to natural work groups on a frequent basis, i.e. every six months or upon project completion, and are based on the number of hours each participant spent on a project, not on salary base. The program is not part of the regular compensation system.

Several of the incentive contracts have interesting variations such as: (1) A bonus for technical performance and on-time launch, (2) "common destiny" contracts involving subcontracts where awards flow down on a shared basis to employees, (3) award fee paybacks for cost overruns with employees receiving IOU's for unpaid awards until success is assured, (4) bonuses shared with employees and major suppliers for successful launches in a series with all bonuses lost if there is a failure, and (5) the merging of small award fee contracts into one larger contract with a combined award fee plan. Each type of award fee plan is put in proposals. Also, more subcontractor involvement is emphasized.

Reward sharing contracts have several benefits. Communication improves dramatically and there is a team building effect. There is higher employee involvement even to the point of employees examining contracts to determine requirements and expectations. Performance levels increase, benefiting the company and pleasing the customer. Such contractual arrangements are necessary for continuous self-improvement.

(From a panel presentation by C. A. Ordahl, McDonnell Douglas Corporation)

7.3 A Direct Government-to-Employee Gainsharing Program

The Grumman Melbourne Systems Division, under its "Joint-STARS" contract with the U. S. Air Force and Army, follows a plan whereby awards go directly from the government to the employees. Awards are also passed down to subcontractors. The arrangement is unusual in that, while the awards are made when performance is above certain minimums, they are keyed to the achievements of significant milestone events for hardware, software, and flight dates. The awards get bigger with later events, putting emphasis toward job completion. The company matches 50% of any government award.

The government maintains a Board, including non-government advisors, that evaluates performance based on predetermined criteria and standards. It is possible for no fee to be awarded, but the contractor may request a debriefing. Each event has evaluation criteria, and the contractor can make recommendations for the next period, but the Board makes the final determination. The fee awards are not negotiable because they are not tied to corporate profitability and they cannot be used for corporate projects.

An internal Grumman Board serves as the focal point for status information and suggestions for improvements. The participating groups have award fee coordinators who decide which

employees receive the discretionary two-thirds after the minimum one-third is distributed to all the involved employees. The discretionary rewards go to individual groups responsible for particular events, after subcontractors are paid. Senior management meets with employees in advance to advise them of the importance of various events.

Reactions to the programs by the government, the company, and the employees have been positive. Internal media is used to publicize the program. Any employees in the program who feel that they were treated unfairly may have their cases heard by the Grumman Board. Only a few disputes have been experienced thus far.

(From a panel presentation by John S. Kempey, Grumman Corporation)

7.4 The NASA Excellence Award

The intent of the NASA Excellence Award for Quality and Productivity is to recognize the highest performance and those who continually try to improve, and to transfer ideas that work to the rest of the community. The award has national impact beyond the aerospace industry.

The Excellence Award Evaluation Team is composed of representatives from NASA Headquarters and NASA Centers. The American Society for Quality Control serves as advisor and administers the process. After a company is determined to be eligible based on the evaluation of an initial application, the company provides in-depth information, in writing, that the team audits and validates. The company site is then visited for further validation.

The number of finalists is not limited, and there is no limit on the number of award recipients from the finalist group. Each year, the system evolves as requirements change, and this year the criteria were adjusted to accommodate hardware, software, and support service types of companies. NASA is proud of the dedication and commitment of the finalist companies. This year, the awards were presented to the IBM Federal Systems Division, Houston and Martin Marietta Manned Space Systems.

(From a panel presentation by C. Robert Nysmith, NASA Director of Quality and Productivity Improvement Programs)

The IBM Federal Systems Division has been supporting NASA Shuttle software development since 1973. New enhancements are continually being added, giving the astronauts more flexibility with each flight. The goals of this program are meeting the customer's intent, performing according to customer expectations, developing safe software, and the ultimate goal of providing completely error-free software.

IBM has achieved high quality with: (1) Top management commitment, (2) work force participation in improvement, (3) vendor involvement, and (4) the IBM Quality Improvement Process. This process is composed of six hierarchical departments. If a software problem is found, all departments that passed the problem must rework it and find out why it happened and why it was not discovered on the first inspection. This process involves non-punitive tracking of errors and is only as good as the people and their attitudes.

The standards IBM sets for quality are that quality is conformance to requirements, no defects are acceptable, the processes must be well defined and understood, and the causes of defects must be removed. The processes are measured continuously, with early detection of errors as the goal. Quality improvement results in productivity improvement.

(From a panel presentation by A. J. Macina, International Business Machines Corporation)

The Martin Marietta Manned Space Systems Company has had a management philosophy in effect for many years which advocates improved efficiencies, effectiveness, and strong social responsibility leading to an improved worker environment and a high quality ethic. This culture was used as the basis to install quality enhancement and productivity improvement programs which involved the entire work force. Issues that had to be taken into consideration were: (1) How to define productivity so that the objectives were clear to all, (2) whether to centralize the program or let individual departments run it, (3) how much employee involvement was necessary, (4) how to motivate and overcome resistance, (5) how to measure results, and (6) how to make achievements real.

Top management set very high cost reduction goals which required each department, in turn, to set their own goals and strategies to achieve them. The productivity office acted as integrator, assisting each department, and verifying that achievements were not made at the expense of other departments. Employee involvement and suggestion programs were established that recognized, by the nature of the products being manufactured and the critical need for mission success, that there were no second chances. The challenge was how to reduce costs, yet maintain error-free performance.

In making a productivity and producibility assessment, it was found that opportunities for cost reduction diminished when moving from the proposal stage to the manufacturing stage and that one had to look at the cost centers, technical drivers, and resources. It helped to know if these had high, medium, or low impact on the goals. Goals have to be set by management, rather than by employee involvement efforts, but the goals have to be communicated down to the subdepartment level, to the employees. The government customer, suppliers, and the entire company must be involved to get commitment.

All recommendations for improvements and increased efficiency are reviewed for possible application and all ideas are retained. Resulting cost reductions are shared with the customer. Successful changes have been made in materials, processes, design, procurement practices, and technology transfers. It was found that quality and productivity changes improved schedules, safety, and profitability. Martin Marietta Manned Space Systems has received many rewards and commendations. The employees and subcontractor employees share in the rewards and the systems are very effective.

Installing and maintaining a quality and productivity improvement program is not easy but the results are gratifying; there have been no product recalls in 13 years, rework is very small, and employee turnover has been significantly reduced. The barriers are people-related; some people are resistant, want to conform to established norms, and fear change. Risk taking has to be taught. A successful program must have management dedication, involvement of the customer, a measurement system, and a reward system. In addition, management must employ good listening skills, set goals, use all resources to carry out efforts, help the subcontractor, and continuously monitor the program.

(From a panel presentation by Dr. Saul R. Locke, Martin Marietta Corporation)

TOPIC 8: A VIEW TO THE FUTURE

8.1 The United States in a Competitive World

For 40 years or more, the United States was viewed as the world leader in products produced by industry, and the space program was the hallmark of our supremacy. But for the last 10 years, foreign competitors have found us to be vulnerable. They have entered our markets and have done very well. A flood of products of higher quality has come in from other nations. We were too complacent and we were putting emphasis in the wrong places.

In the 1960s and 70s, we were learning to manage by watching numbers in our offices. We didn't get out to see what was happening. We were taught to manage by exception, where one doesn't know what is going wrong until it is too late. Meanwhile, other nations were learning how to improve quality by using statistical methods. We were hiring people for their hands and not taking advantage of their brains. We put quality in the hands of inspectors and not the workers who had the best knowledge of what they were producing. We deprived the workers of the job satisfaction they could have gotten from the job. Workers don't care if their bosses don't care and there was clear evidence that senior management wasn't visible. We denied them in the 70s and we're still doing it in the 80s.

About six years ago, we started a productivity improvement and quality enhancement program for NASA and its contractors, recognizing that quality and productivity go together. Deming and Juran would report that in industry, poor quality consumes 25to 30% of production costs. The media has reported recently that over 50% of more than 600 executives polled thought the cost was 10%. Other survey results showed that quality would be the most pressing problem in the next three to five years (although quality and productivity go together); 85% thought the solution was better employee motivation, while 82% thought the solution required a change in corporate culture. The priority of these two solutions should be reversed. We need changes in thinking at the top.

In 1980, the flight of American business to foreign countries was 10%. In 1987, this number rose to 18% and, although flight appears to be abating, there is no strong optimism. In the long term, we must improve quality and be more productive, but if not, the percentage of flight will increase.

We must spend more on R&D. In 1986, only 2.3% of the Gross National Product was spent on R&D, down from 3% in previous years. Other areas that have to be looked at are: (1) Changes in corporate cultures down to managers and supervisors to emphasize quality in products produced, (2) effective time management systems to improve quality and to make management more available to the people who work for them, and (3) effective communication systems for understanding complaints from customers and for learning about problems in manufacturing processes. Foreign nations look upon us as a great opportunity. We must meet this challenge.

Today, we observe that the space program has gone through a lot of travail and we have been abandoned by some. Yet, we have to do more with the dollars we get. We are getting back into space, but we can't wish ourselves back. We have to work hard to regain our leadership position. Foreign competition is there.

We will fly again next year, and then,

often. Projections we have made are conservative and we will better them. "If you want to do something important, you have to pay the price with sweat, hard work, and dedication. We have it in our hands; no one can do it for us. The only thing we have to fear is that we will lose our will. As long as we do not doubt, we can do anything we want to. We've never feared before and let us never fear in the future."

(From a Presentation by the Honorable James M. Beggs, Former NASA Administrator)

8.2 Competition and Productivity

Foreign challenges in space programs are the same as competition in industry, but competition is the best process for improving quality and productivity. Boeing is improving productivity to be more competitive. The military and space budgets will probably stay the same or even decline, and we need to work problems together with NASA in a spirit of cooperation. Yet, we have to make a profit. There are other governments that support their commercial aircraft programs and the competition is fierce. We have to control costs to meet the challenge. We have to maintain high quality and performance standards.

Specifically, we must convey a sense of urgency to line management and employees about future peril. We must achieve higher performance, although performance in the past has been laudatory. We must have better communication, and use every communication technique available to obtain a realization of the importance of productivity to everyone involved, including the union and suppliers, and hold forums to learn about our performance.

We must eliminate the obstacles of "not invented here" and "invented here," and institute a culture that accepts and encourages improvements. We have to look for new ways to improve, to work smarter, and to motivate people to strive for constant improvement. When improvement occurs, we must acknowledge it and publicize it, regardless of previous successes; and we have to single out people and reward them. We have to work from the bottom up, but also top down.

Several improvements already made include streamlined procurement processes driven by schedules, automation, computer decision trees, and supplier involvement to reduce time and costs. Technology improvements have been made, such as the assembly of electrical connectors, that have been automated using expert systems in artificial intelligence. Established company systems can also be improved by using suggestion programs and increasing rewards. The number of suggestions submitted by Boeing employees doubled in 1986.

These are all incremental changes, but management has to examine systems to be effective in short-term development contracts. We must rely more on the judgment of our people instead of complex systems. Questioning the structure of an organization also derives benefits.

In our commercial aircraft division, we are using multidiscipline teams in initial design and have adopted a practice of preventing problems by building quality up-front, rather than inspecting for quality. There is a feeling of pride throughout the program; we believe we can offer a better product at a lower cost. A broad approach is needed to improve productivity. The U. S. can meet the challenge of international competition with clear direction, appropriate resources, and dedication to excellence.

(From a presentation by Frank A. Shrontz, President and Chief Executive Officer, The Boeing Company)

8.3 The Next Shuttle Mission

The public wants to know what it is like to be an astronaut. Depending on the audience, that question might mean what is it like to: (1) Fly on a rocket with the thrust of 300 jet fighters controlled by the most complex assemblage of hardware and software built by man, (2) spend eight days with four other people in a compartment so small, you can touch all walls at the same time, (3) call home on a communication system to which the whole world can listen, (4) come back to Earth in a fire ball of hot plasma, or (5) know you have one chance to land a 300,000 pound glider that cost the tax payers billions of dollars, and if not successful, could deal a crushing blow to the country's space program? But the most popular question is what is it like to float and see the Earth's surface from above? And the answer is, "it is exhilarating and great."

Young people want to know what they have to do to become an astronaut. They have to study hard, broaden their interests and not become one subject experts, stay physically fit, have fun, be team players and learn to communicate well, learn to listen, and learn not to be afraid to make mistakes, but admit them, and learn from them.

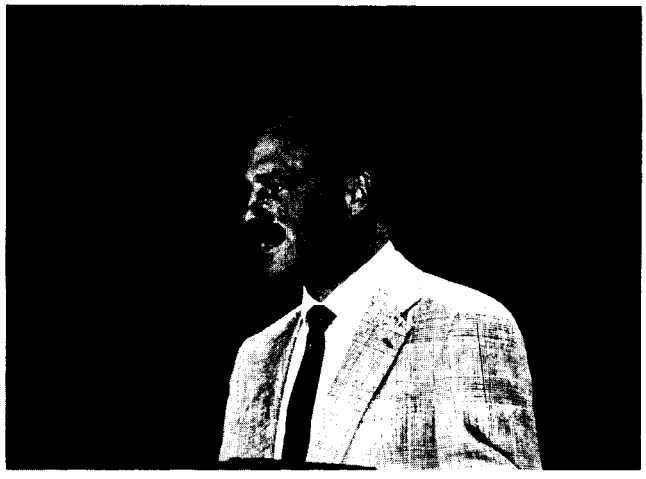
The Challenger was a great loss to all, personally, economically, and from the standpoint of national prestige. Engineering and scientific opportunities were lost or deferred. Now, we are recovering and rebounding, but we are doing it with deliberate speed and caution.

The astronauts stake their lives on quality. We have been visiting people in the NASA/Contractor family and we are encouraged by the changes in hardware and team building. We have seen over 20,000 people, many eye-to-eye, and they have seen the astronauts who will fly their products. It's been a very positive experience and enthusiasm is growing. We have learned some lessons and will have a stronger space program as a result.

The new crew patch has particular meaning. The plume following the shuttle represents a safe launch and a safe landing. The sunrise represents a new beginning. We remember our seven colleagues from the Challenger by the seven stars in the big dipper. The red vector that cuts across the patch represents NASA's traditional strengths. When the Shuttle is launched, we know you will all be riding with us.

(From a Presentation by Captain Frederick H. Hauck, USN, NASA Astronaut, Commander of the Next Shuttle Flight)

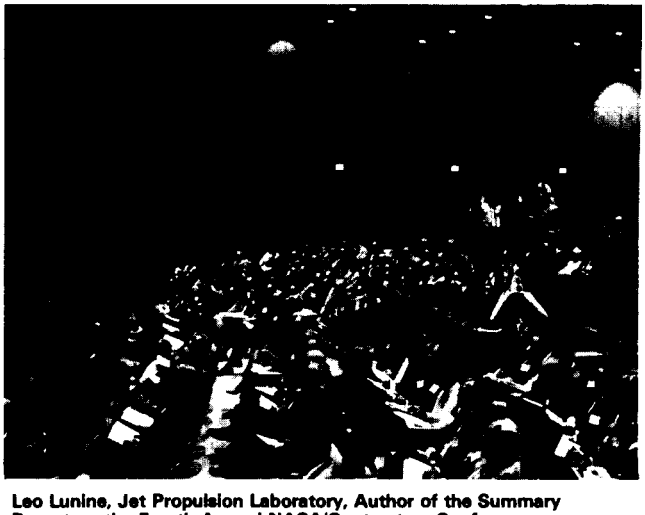
Frank A. Shrontz, President and Chief Executive Officer, The Boeing Company



Captain Frederick H. Hauck, USN, Astronaut, Commander of the next Shuttle Mission

The Honorable James M. Beggs, Former NASA Administrator; Aaron Cohen, NASA Johnson Space Center

Dale D. Myers, NASA Headquarters; Aaron Cohen, NASA Johnson Space Center; George B. Merrick, Rockwell International Corporation



Leo Lunine, Jet Propulsion Laboratory, Author of the Summary Report on the Fourth Annual NASA/Contractors Conference (Row 3, Seat 1)

APPENDIX A - CONFERENCE PROGRAM

FOURTH ANNUAL NASA/CONTRACTORS CONFERENCE ON QUALITY AND PRODUCTIVITY

Lyndon B. Johnson Space Center
Houston, Texas
October 27-28, 1987

"Achieving Excellence Through Teamwork"

Tuesday, October 27

7:30 - 7:55 a. m.	Conference Check-in and Badging
8:00 - 8:10	Welcome - **Aaron Cohen,** Director, Lyndon B. Johnson Space Center
8:10 - 8:45	Keynote - **Dale D. Myers,** NASA Deputy Administrator
8:45 - 9:00	Conference Overview - **C. Robert Nysmith,** Director, NASA Quality and Productivity Improvement Programs
9:00 - 10:30	PANEL A - NASA Program Direction for the Future - NASA Technical Panel to give a technical overview of NASA program direction for the future. **Dr. Terence T. Finn,** Deputy Director, Policy Division, Office of Space Station **Dr. Raymond S. Colladay,** Associate Administrator for Aeronautics and Space Technology **H. Hollister Cantus,** Associate Administrator for External Relations **C. Robert Nysmith,** Director, NASA Quality and Productivity Improvement Programs **(Moderator)**
10:30 - 10:50	Break
10:50 - 12:00	PANEL B - Building Quality into NASA's Programs/Products/Culture - Discussion of NASA's safety, reliability, maintainability and quality assurance objectives with emphasis on the area of building quality into NASA's programs, products and culture. **George A. Rodney,** Associate Administrator for Safety, Reliability, Maintainability and Quality Assurance **(Chairman)**

Joseph A. Bethay, Executive Assistant to the Director, George C. Marshall Space Flight Center

David A. Geiger, Director, SSME Quality, Reliability, & System Safety, Rocketdyne Division, Rockwell International Corporation

Joyce R. Jarrett, NASA Headquarters, Panel Coordinator

12:00-12:30 p. m. Travel to Gilruth Recreation Center

12:30 - 2:00 Buffet Lunch/ Luncheon Speaker: **Frank A. Shrontz**, President and Chief Executive Officer, The Boeing Company - **"Competition and Productivity"**

2:00 - 5:30 SUCCESS STORIES (Panel Presentations)

(Panel presentations may be attended at the discretion of the conference attendee)

2:00 - 3:00 PANEL C

Panel C1 - Employee Motivation - This panel will explore the concept of employee motivation from the distinct perspectives of an 8A support services contractor and a prime contractor in the process of rebuilding motivation.

Gerald L. Johnson, Project Manager, Boeing Computer Support Services, Huntsville (Co-Chairman)

J. N. Foster, Director, Institutional and Program Support, Marshall Space Flight Center (Co-Chairman)

Alfredo Bonilla, III, Project Manager, Base Maintenance Mission Services Contract, Brown and Associates Management Services, Inc. (BAMSI) - **"Employee Motivation"**

John R. Wells, Director, Space Operations, Space Division, Morton Thiokol - **"Recovering from Disaster—A Motivational Challenge"**

Larry E. Lechner, Marshall Space Flight Center, Panel Coordinator

Panel C2 - Johnson Space Center (JSC) Team Excellence Overview - The presentations will (a) briefly describe the JSC Team Excellence program and its results to date, (b) the integration of the strategic planning process with the program, and (c) the various types of contractor participation in the program including the JSC/Contractor Forum.

Robert B. Young, Jr., President, Lockheed Engineering & Management Services Company **(Chairman)**

Daniel A. Nebrig, Executive Assistant to the Director, Johnson Space Center - **"Implementing A Centerwide Enhancement Effort"**

William J. Huffstetler, Assistant Director, Engineering, Johnson Space Center - **"Integrating Strategic Planning and Team Excellence"**

Peter W. Sivillo, Senior Staff Scientist for Space Programs, Singer Company - **"Encouraging Contractor Participation: The JSC/Team Excellence Forum"**

Leslie J. Sullivan, Johnson Space Center, Panel Coordinator

Panel C3 - Quality Up-Front - A discussion of how quality can be built into a product versus inspecting and reworking quality into the product.

W. Brian Keegan, Deputy Director, Office of Flight Assurance, Goddard Space Flight Center **(Chairman)**

Thomas L. Clark, Director, Product Assurance, System Sciences Division, Computer Sciences Corporation - **"How We Build in Software Quality Up-Front"**

Jerome Barsky, Project Manager, NASA - Mission Operational Support, Allied Bendix Aerospace, Bendix Field Engineering Corp. - **"Success of a Service Support Contractor"**

B. J. Thomas, Manager, STS Programs, Federal Systems Division, Houston, IBM - **"General Purpose Computer Upgrade for the Shuttle"**

Ray J. Rogal, Director, Corporate Quality Office, Ford Motor Company - **"Total Quality Excellence Program"**

Gene Guerny, Goddard Space Flight Center, Panel Coordinator

3:00 - 3:15 Break

3:15 - 4:15 PANEL D

Panel D1 - Measurement Successes - To develop an appreciation for the benefits of measurement through an anecdotal approach relating specific successes and insights in aerospace related work units. **(Interactive Forum)**

Dr. Marco J. Giardino, Productivity Coordinator, Pan American World Services **(Chairman)**

Franklin R. Hagy, Manager, Applications Development, EG&G Florida, Inc.

Peter W. Sivillo, Senior Staff Scientist for Space Programs, Singer Company

Peter L. Kujawski, Program General Manager, Science & Application Programs, Astro-Space Division, General Electric Company

Eugene N. Elleman, Productivity Enhancement Manager, Cortez III Service Corporation

Dr. Gerald C. Swanson, Boeing Aerospace Company Improvement Manager

Debra Owens, Project Manager, American Society for Quality Control **(Moderator)**

Ronnie E. Carter, National Space Technology Laboratories, Panel Coordinator

Panel D2 - Johnson Space Center Team Excellence Case Studies - The presentations will briefly describe three in-depth, systematic, assessment/action planning projects using extensive employee involvement, both civil service and contractor, to improve organizational and/or systems performance.

Paul J. Weitz, Deputy Director, Johnson Space Center **(Chairman)**

Elsie M. Easley, Chief, Logistics Division, Center Operations Directorate, Johnson Space Center - **"Logistics: A Participative Approach to Improving Organizational Performance"**

Lubert J. Leger, Ph.D, Chief, Materials Branch, Structures & Mechanics Division, Engineering Directorate, Johnson Space Center - **"Structures and Mechanics: Developing an Organizational Technology and Capabilities Roadmap"**

Rodney G. Rose, Senior Technical Advisor to the RSOC Program Manager, Rockwell Shuttle Operations Company - **"Reconfiguration Management: A Joint Approach"**

Leslie J. Sullivan, Johnson Space Center, Panel Coordinator

Panel D3 - Beyond Quality Circles - Quality Circles have provided a foundation for expanded employee involvement ranging from employee participation teams to selected experiments in self-managed teams with no first line supervisors. This panel will present first hand experiences of innovative employee involvement programs from two diverse organizations.

Sidney F. Pauls, Associate Director, Langley Research Center **(Chairman)**

Julie Holtry, Marketing & Communications Manager, Corporate Quality, Hewlett-Packard Company - **"Teamwork: A Breakthrough Approach"**

John G. Teixeira, Plant Manager, Electronic Assembly Plant/College Station, Defense & Electronics Operations, Westinghouse Electric Corporation - **"Computer Integrated Manufacturing (CIM)—Integrated Systems, Technology and People"**

William L. Williams, Langley Research Center, Panel Coordinator

4:15 - 4:30 Break

4:30 - 5:30 PANEL E

Panel E1 - Team Building Activities-Hardware - This panel will present both an overall perspective of team building and specific team building examples with achieved results.

Richard Schwartz, President, Rocketdyne, Rockwell International Corporation - **"The Merits of Teamwork - Rocketdyne's Efforts in Team Building" (Chairman)**

Dr. Gregory M. Sanger, Director, Optics Technology, The Perkin-Elmer Corporation - **"Focused for Effectiveness"**

Janiss H. Graves, Project Engineer, Hubble Space Telescope, Huntsville Research & Engineering Center, Lockheed Missiles & Space Company, Inc. - **"The Hubble Space Telescope Management System - A Building Block in Building a Team"**

Michael Parfitt, Director, Product Assurance and Productivity Coordinator, Remote Manipulator Systems Division, Spar Aerospace Limited - **"Team Building Through Participation"**

Larry E. Lechner, Marshall Space Flight Center, Panel Coordinator

Panel E2 - Team Building Activities-Support Service - Through presentations of successful service support team building experiences the conference attendees can develop or expand their team building relationship for successful achievements.

Andrew J. Pickett, Associate Deputy Director, John F. Kennedy Space Center (Chairman)

Norman Struzynski, Engineering Branch Manager, CALSPAN Corporation - **"The NASA/Ames CALSPAN Experience"**

Charles L. Gibbons, Deputy General Manager, EG&G Florida, Inc. - **"Contract Consolidation: How To Put A Team Together"**

Warren L. Camp, Kennedy Space Center, Panel Coordinator

Panel E3 - Gainsharing - Implemented Government/Contractor gainsharing programs will be described in terms of their effect in fostering innovation, increasing employee motivation and improving efficiency as well as lessons learned, obstacles overcome and potential pitfalls.

Frank E. Doherty, Assistant for Industrial Productivity and Quality, Office of the Assistant Secretary of Defense for Production and Logistics - **"Gainsharing—Productivity and Quality Connection"** (Chairman)

John S. Kempey, Manager of Contracts, Grumman Melborne Systems Division, Grumman Corporation - **"Award Fee Program: Joint-STARS"**

C. A. Ordahl, Vice President Deputy General Manager, Space Station Division, McDonnell Douglas Astronautics Company - **"Reward Sharing"**

Lezley K. Wilson, Ames Research Center, Panel Coordinator

Panel E4 - Sub-Contractor Role in Productivity and Quality Enhancement Programs

Richard M. Davis, Corporate Vice President & President, Manned Space Systems, Martin Marietta Corporation - **"Sub-Contractor Productivity and Quality Enhancement - A Shared Responsibility" - (Chairman)**

Angelo Guastaferro, Director, Space Station Program, Lockheed Missiles & Space Company, Inc. - **"The Traditional Prime As A Sub-Contractor"**

Lindsay Ball, Program Manager, Space Station, Honeywell, Inc. - **"Productivity Improvement for Traditional Sub-Contractors"**

Joyce R. Jarrett, NASA Headquarters, Panel Coordinator

5:30 - 6:00 Travel to hotels (Bus or car)

6:30 - 7:00 Travel from hotels to Nassau Bay Hilton (Bus or car)

7:00 - 8:00 Reception

8:00 - 10:00 Dinner/Dinner Speaker: **The Honorable James M. Beggs,** Former NASA Administrator - **"The United States in a Competitive World"**

10:00 - 10:30 Travel to hotels (Bus or car)

Wednesday, October 28

7:15 - 8:00 a.m. Travel by bus or car to Gilruth Recreation Center, Johnson Space Center

8:00 - 10:00 **NASA EXCELLENCE AWARD** - (Panel Presentation)

PANEL F

8:00 - 8:30 C. Robert Nysmith, Director, NASA Quality and Productivity Improvement Programs, Introduction to NASA Excellence Award/Winners

8:30 - 9:00	IBM NASA Excellence Award Presentation, **A. J. (Tony) Macina,** Manager of Onboard Shuttle Software, IBM Federal Systems Division Houston Facility - **"Space Shuttle Primary Software Quality Program"**
9:00 - 9:30	**Martin Marietta** NASA Excellence Award Presentation, **Saul R. Locke,** Director of Productivity, Martin Marietta Manned Space Systems - **"Productivity and Quality Enhancement Practices: A Case Study"**
9:30 - 10:30	Panel F Question and Answer Period
10:00 - 10:15	Break
10:15 - 12:30	CONTRACT INCENTIVES (Roundtable Work Groups)

PANEL G - Contract Incentives for Quality and Productivity Improvement - A panel discussion on quality and productivity incentives, followed by interactive working sessions to develop new techniques. The panel discussion features an overview by the NASA Deputy Assistant Administrator for Procurement on current policy and practices, as well as presentations by hardware and support contractors highlighting their experiences. After a brief question and answer period, the interactive working sessions will provide participants the opportunity to recommend changes and develop new ideas for incentive mechanisms.

Leroy E. Hopkins, Deputy Assistant Administrator for Procurement, NASA Headquarters **(Chairman)**

F. Craig Wilson, Vice President, Cortez III Service Corporation and **Ronald Kiessling,** Deputy Chief, Logistics Management, Lewis Research Center - **"Application of Productivity Fee in Support Service Contracting"**

Jacob J. Bussolini, Vice President, Business Operations, Corporate Services Division, Grumman Corporation - **"Aircraft Contractual Incentives Applicable to Space"**

C. Robert Nysmith, Director, NASA Quality and Productivity Improvement Programs **(Facilitator)**

David J. Steigman, Lewis Research Center, Panel Coordinator

12:30-2:00 p.m.	Buffet Lunch/Luncheon Speaker: **Captain Frederick H. Hauck, USN,** NASA Astronaut, Commander of the next Shuttle Mission
2:00 - 2:15	Feedback on "Contract Incentives" panel and adjourn: **C. Robert Nysmith,** Director, NASA Quality and Productivity Improvement Programs
2:15 - 2:30	Board Busses for Johnson Space Center demonstrations or busses or car to return to hotels. (Optional)
2:30 - 5:00	Special demonstrations at three Johnson Space Center facilities.
5:00 - 5:30	Travel to hotels (Bus or car)

NASA/Contractors Conference Planning Team

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Ronnie E. Carter
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A Special Thanks To The
Johnson Space Center/Contractor Team Excellence Forum
For Administrative And Logistic
Support Of This Conference

(left to right) I. Jerry Hlass, H. Hollister Cantus, Richard Davis, George Rodney, Frank Shrontz, Aaron Cohen, Dr. Lew Allen, Richard Schwartz

(left to right) Richard Davis, Hugh Brown, George Rodney, Mary Beggs, C. Robert Nysmith, Aaron Cohen, James Beggs, Alan Lovelace, Dr. Thomas Williams, Murray Weingarten

(left to right) C. Robert Nysmith, Aaron Cohen, James Beggs, Alan Lovelace, Dr. Thomas Williams

APPENDIX B - ACKNOWLEDGMENTS

The papers, graphics, audio presentations and panel notes from the conference were used as the basis for writing this report.

Almost two score individuals deserve recognition for their work in organizing the Fourth Annual NASA/Contractors Conference: the Conference Chairman, **C. Robert Nysmith** and the Conference Project Manager and Coordinator, **Geoffrey B. Templeton**, NASA Quality and Productivity Improvement Programs; the Center Conference Steering Committee: **R. Wayne Young, Leslie J. Sullivan, Alma S. Martin** and **Wanda M. Thrower**, Management Analysis Office, Johnson Space Center; the panel coordinators and members of the NASA/Contractors Conference Planning Team: **C. Robert Nysmith**, Conference Chairman (NASA Panel A: NASA Program Direction for the Future, Panel F: NASA Excellence Award, and Panel G: Contractor Incentives); **Larry E. Lechner**, Productivity Improvement Office, Marshall Space Flight Center (Panel C1: Employee Motivation and Panel E1: Team Building Activities - Hardware); **Leslie J. Sullivan**, Chief, Management Analysis Office, Johnson Space Center (Panel C2: Johnson Space Center Team Excellence Overview and Panel D2: Johnson Space Center Team Excellence Case Studies); **Gene Guerny**, Special Programs Officer, Goddard Space Flight Center (Panel C3: Quality Up-Front); **Ronnie E. Carter**, Chief, Institutional Services, National Space Technology Laboratories (Panel D1: Measurement Successes); **William L. Williams**, Productivity Officer, Langley Research Center (Panel D3: Beyond Quality Circles); **Warren L. Camp**, Chief, Institutional Management Office, Kennedy Space Center (Panel E2: Team Building Activities - Support Service); **Lezley K. Wilson**, Management Analyst, Administrative Directorate, Ames Research Center (Panel E3: Gainsharing); and **David J. Steigman**, Productivity Program Manager, Lewis Research Center (Panel G: Contractor Incentives); the members of the NASA/Contractors Conference Planning Team not previously acknowledged: **B. A. Chamberlain**, Ford Aerospace and Communications Corporation; **John J. Culp**, Omniplan Corporation; **J. Jeannette Eads**, EG&G Florida, Inc.; **Eugene N. Elleman**, Cortez III Service Corporation; **Marco J. Giardino**, Pan Am World Services, Inc.; **Howard H. "Joe" Kintzel**, Teledyne Brown Engineering; **Saul R. Locke**, Martin Marietta Corporation; **Stuart K. Manville**, Lockheed Engineering and Management Services Company, Inc.; **Leroy J. Mendenhall**, Boeing Computer Support Services; **Rick L. Meyers**, Calspan Corporation; **George Nelson**, Sverdrup Technology, Inc.; **Theodore Pykosz**, Computer Sciences Corporation; **Lynwood P. Randolph**, NASA Headquarters; **William R. Reynolds**, Marshall Space Flight Center; **Edward G. Siebert**, Grumman Corporation; **Libby Varty**, Bionetics Corporation; **Darrell E. Wilcox**, Ames Research Center; **Charles E. Zimmerman**, Westinghouse Electric Corporation; and for administrative and logistic support of the conference, the **Johnson Space Center/Contractor Team Excellence Forum.**

A special note of appreciation is extended to **Leo R. Lunine**, Section Manager, Jet Propulsion Laboratory for conceptualizing this report, synthesizing the thoughts presented by the conference speakers and writing this document and to his editors, particularly **Charlotte Marsh**, Jet Propulsion Laboratory and **Bonnie Kunkle**, Jet Propulsion Laboratory.

The staff of the NASA Quality and Productivity Improvement Programs Office made valuable contributions to the final report, especially **Geoffrey B. Templeton, Lynne M. Stewart,** and **Francine Palestis.** A special thanks to **Lynne M. Stewart** for the final editing and consolidating of this project.

Joyce R. Jarrett, Director, NASA Quality and Productivity Improvement Programs